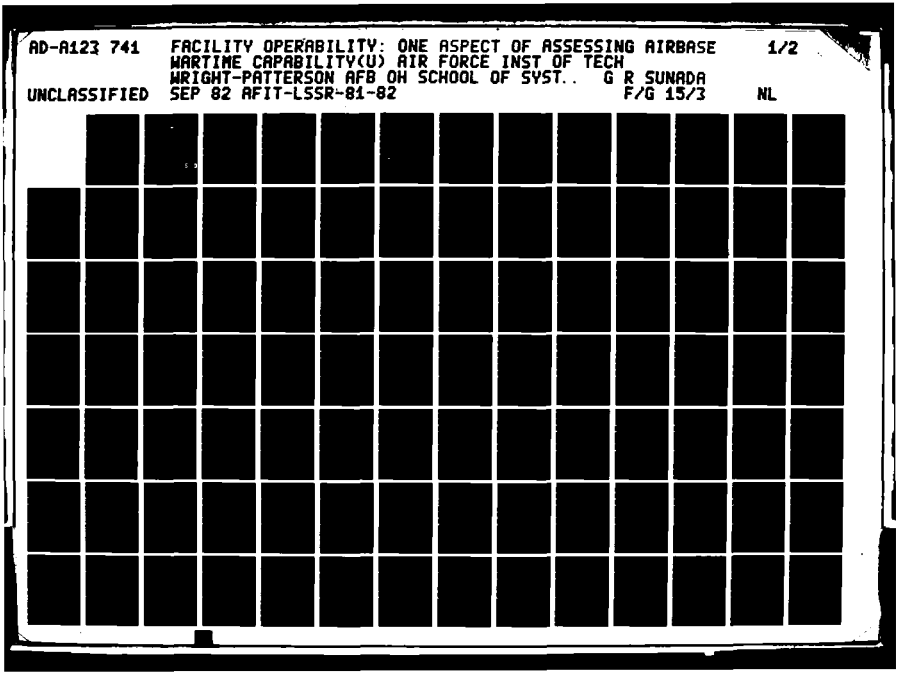
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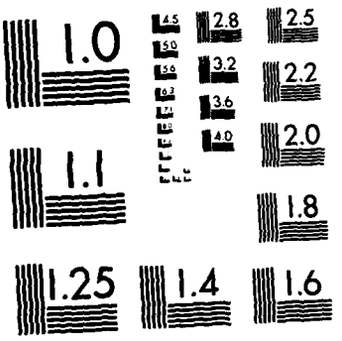

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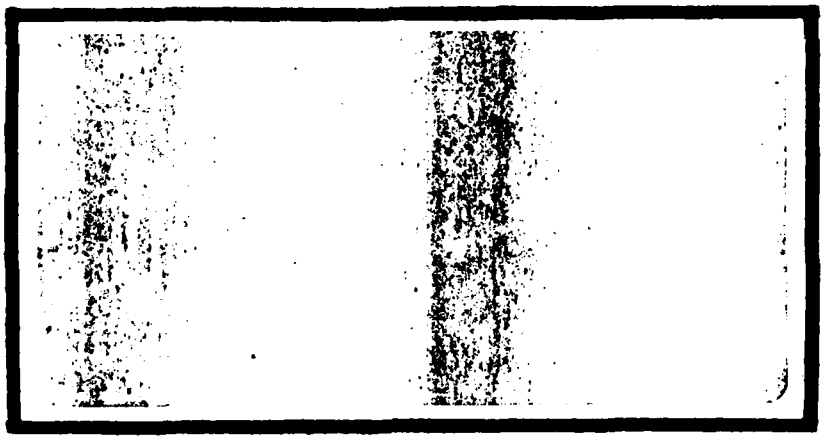

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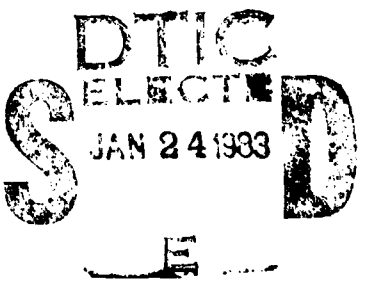
FACILITY OPERABILITY: ONE ASPECT OF ASSESSING AIRBASE WARTIME CAPABILITY

G. Roger Sunada, Captain, USAF

LSSR 81-82



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Thesis Chairman: John W. Mogge, Jr., Captain, USAF

Thesis Reader: Professor James D. Meadows, GS-13

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Air Force Civil Engineers are responsible for the facilities in support of military forces, weapon systems, aircraft, and personnel. These facilities are a significant element, vitally important to the capability and readiness of our nation's military force. Yet existing Air Force capability and readiness reporting systems do not call for an assessment of airbase facilities. This study sought to (1) develop the concept that facilities affect airbase capability and readiness; (2) determine goals, objectives, and criteria for developing a system to measure capability and readiness of facilities; (3) propose a model system for assessing capability and readiness of facilities as they relate to an airbase's military mission. "Facility Operability" is defined as: the operating capability of facilities as they relate to the military mission of an airbase. A Model Facility Operability Measurement System is developed. Recommendations for further research include the use of a Facility Operability Measurement System: as a management tool for Civil Engineering Managers; by post-attack Damage Assessment Teams; for inclusion in the UNITREP System; by architects and planners; by ORI or IG teams; and in conjunction with combat simulation systems.

LSSR 81-82

FACILITY OPERABILITY: ONE ASPECT OF ASSESSING AIRBASE WARTIME CAPABILITY

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Engineering Management

By

G. Roger Sunada, BLA
Captain, USAF

September 1982

This thesis, written by

Captain G. Roger Sunada

has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN ENGINEERING MANAGEMENT

DATE: 29 September 1982

COMMITTEE CHAIRMAN

James D. Meadows

READER

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"The far-sighted people of the world win everything in the battle of life. Those who are short-sighted fail." (From: Future Seeing by Edmund Shaftesbury, 1926).

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CHAPTER 1

INTRODUCTION

The Air Force Civil Engineers are responsible for approximately 135 major operational airbases or installations world-wide (39). They are responsible for real estate, airfields, roadways, buildings, and utilities. They are involved in the acquisition, construction, operation and maintenance of real property facilities as well as in leasing and mortgage dealings (34:2). The Air Force Civil Engineering (CE) manager is responsible for the facilities in support of military forces, weapon systems, aircraft, and personnel.

The Civil Engineers are a significant element, vitally important to the readiness and capability of our nation's military force, however their functions are not as conspicuous as those of an operational aircraft pilot and crew. The effectiveness of the CE manager and the mission of the CE organization is just as significant and vital as the effectiveness of an aircraft crew and their mission.

Evaluating the contribution to readiness and wartime capability are concerns common to military managers working in aircraft operations, as well as in a support function. Air Force Manual (AFM) 1-1, Functions and Basic Doctrine of the United States Air Force, (32) describes the mission of the United States Air Force:

> The mission of the United States Air Force is to prepare our forces to fight to preserve the security and freedom of the people of the United States. Our goal is peace. To achieve this goal we must deter conflict by maintaining a force that is capable and ready [(emphasis added)] [32:v].

If our forces are sufficiently capable and ready, our goal of peace can be met. Air Force managers in turn should be able to measure the effectiveness and performance of their respective functions in order to control and improve the state of capability and readiness of the forces.

Measuring readiness and capability is difficult. Robert N. Anthony in Management and Control in Non-Profit Organizations (4) identifies the problem of measuring the performance of the Department of Defense: "The output of the Department of Defense is 'readiness to defend the interest of the United States' - terms that are difficult to define and impossible to quantify [4:39]." Anthony goes on to explain that "the amount and quality of service rendered is not measured by the numbers in the financial statements. Performance with respect to the important goals is difficult to measure [4:39]."

PROBLEM STATEMENT

A number of Air Force regulations and defense related reports describe systems which are designed to measure and report capability and readiness (1; 3; 13; 17; 18; 21; 23; 26; 27; 29). These systems evaluate a number of the

factors (such as personnel, equipment, training, etc.) which affect the capability and readiness of our forces. None of these systems call for an assessment of airbase facilities.

RESEARCH OBJECTIVES

The challenge set forth in this thesis is to develop a system of quantifying the measurement of airbase capability and readiness from a Civil Engineering perspective. The objectives of this research are:

1. Develop the concept that facilities affect the capability and readiness of an airbase's military mission.

2. Determine goals, objectives, and criteria for developing a system to measure the capability and readiness of airbase facilities.

3. Propose a model system for assessing the capability and readiness of facilities as they relate to an airbase's military mission.

PROBLEM ANALYSIS

Regardless of the difficulties set forth by Anthony, difficult terms have been defined and measurable goals have been identified as they relate to assessing the capability and readiness of facilities.

Readiness

During the first half of this century combat readiness was of primary concern during times of war.

Readiness levels drastically decreased when the United States was not at war (3:7). During this period of time the nature of warfare allowed for preparations to be made after the combat had started. With the increasing complexity of weapon systems and the magnification of their destructive power, wartime readiness in peacetime has become more important (3:7).

Air Force Chief of Staff, General Lew Allen, Jr. stated in May 1982,

> Our chief adversary, the Soviet Union, has demonstrated an increased willingness to use its growing military might to extend its sway and threaten Western interests [2:78].

Recognition of the Soviet threat has led to the use of readiness as the watchword of today's military forces.

> Alert crews are fully prepared to dash to fueled, armed aircraft; strategic and tactical airlift crews and aircraft are ready to deliver men and materials; facilities are positioned and ready for combat use [40:32].

Readiness means different things in different situations and is expressed in different ways for different purposes. The dictionary defines readiness as "the quality or state of being prepared or equipped to act or be used immediately [16:1182]."

The fact that a combat unit is more or less ready to perform its combat mission applies to "unit readiness." The term "personnel readiness" refers to the overall availability and proficiency of the personnel assigned to a force

or unit. The term "logistics readiness" is used when referring to the readiness of the logistics system to support a particular system or equipment. One researcher (21:8) described these different uses of the term readiness as "objects of readiness."

The Air Force Civil Engineer finds application in each of these objects of readiness. None address the main function of the Air Force Civil Engineer: the physical plant or facilities, in support of forces, weapon systems, aircraft, and personnel. A term "facility readiness" (12:4-7; 40:32-33) may be added to the previous list for the Air Force Civil Engineer (Table 1).

TABLE 1

READINESS OBJECTS

Unit Readiness
Personnel Readiness
Logistics Readiness
Materiel Readiness
Equipment Readiness
Facility Readiness

These readiness objects are dependent on varying elements such as training, skills, availability, morale, etc., for personnel; and reliability, maintainability or capability, etc., for equipment. Readiness objects and their underlying elements all interrelate to form a system of dedicated efforts required to achieve combat readiness. Force effectiveness is determined by the capability of the

units in a force to operate and remain operable, the size of the force, the specific threat they face, and the strategy and tactics of the command (17:3). A simplified conceptual systems diagram is shown in Figure 1.

This research effort focuses on facility readiness and its relationsnip to the Air Force readiness and effectiveness system.

Readiness Measurement

The importance of readiness is clearly defined. The measurement of readiness, however, is not so well defined. The measurement of readiness and effectiveness at any of the unit or force levels is, of course, dependent upon the data available and upon a system by which the data can be evaluated.

A number of tools are used by the Air Force to measure/manage force capability and readiness. Some have been in existance for many years and some have been developed as a result of emphasis in the last ten years (1:508).

> Yet, a precise method of measuring or assessing total force readiness has not yet been discovered or devised. The main causes for the inability to formulate such a method lie in these questions: "What is ready? What does ready mean? Ready to do what?" Some of the elements that make up a determination of "what is ready or not ready" are quantifiably comparable, while others, equally important, are purely qualitative and judgmental [1:508].

Currently there are no systems capable of identifying all the elements and measuring force readiness (1:508).

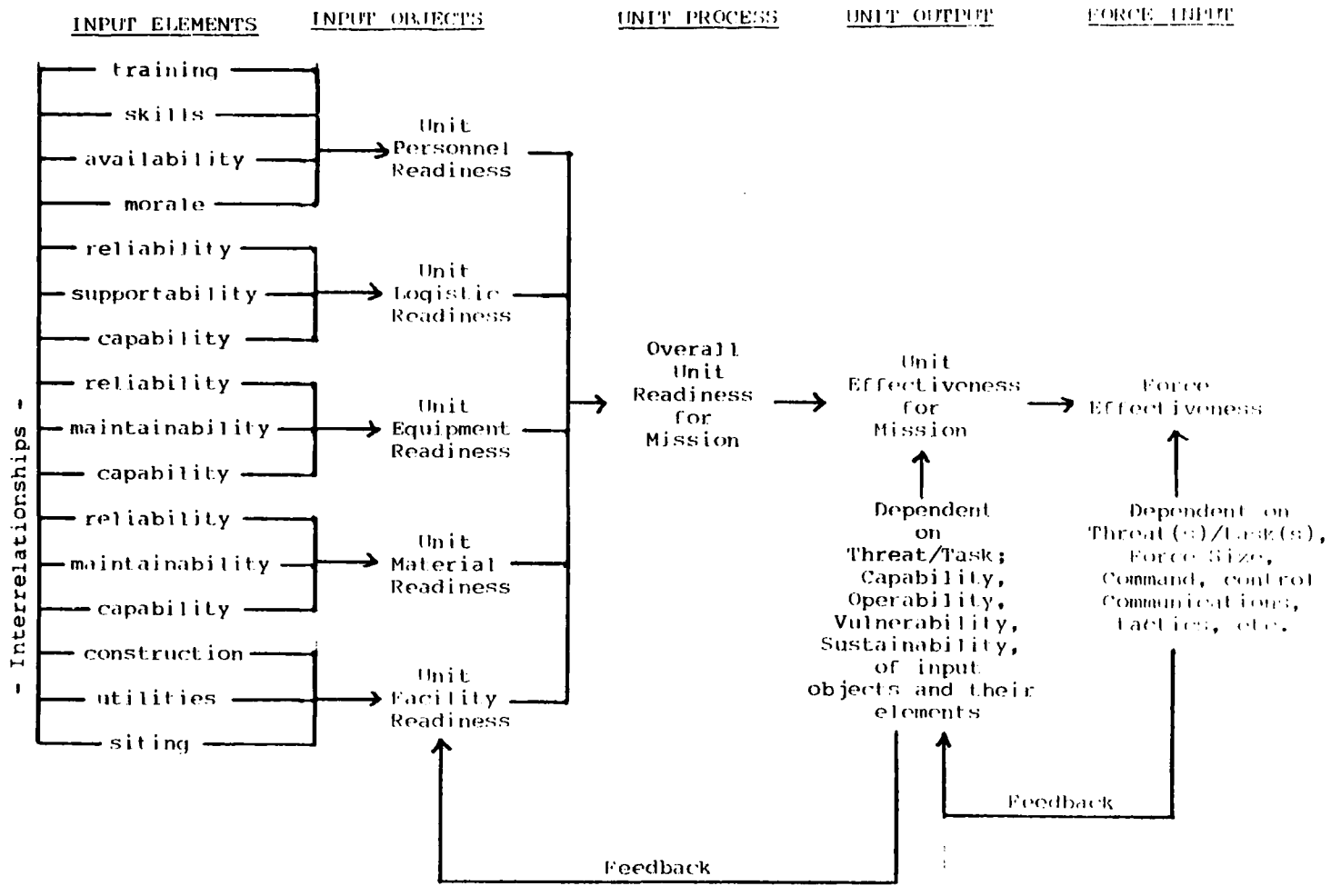

Figure 1

Conceptual Model - Readiness and Effectiveness System
adapted from (17:4)

The Air Force is required to report combat readiness by Headquarters Air Force as prescribed in Joint Chiefs of Staff (JCS) Pub 6, Volume II, part 1, Chapter 1, section 6 (18). Air Force Regulation (AFR) 55-15, Combat Readiness Reporting (29) gives the policies, procedures, and criteria, and sets forth requirements to support the Unit Status and Identity Report (UNITREP). Each Major Command (MAJCOM) specifies a unit capability requirement called the Designed Operational Capability (DOC) statement. The DOC requires the reporting of specific resources and requirements for a unit to perform 100% of its mission. Unit level combat readiness is reported by the UNITREP (UNITREP has replaced two previous systems, Air Force Unit Capability Measurement System (UCMS) and JCS Force Status (FORSTAT) report (27: 4-4; 1:508)).

The unit commanders determine unit readiness and measure resources of personnel, equipment, and training. UNITREP data is reported over the Automatic Digital Network (AUTODIN) to the MAJCOM. The MAJCOM consolidates the reports and forwards them to the JCS (1:508; 29:1-1, 1-2). The JCS are responsible for force readiness as well as the management of resources which relate to force readiness. DOD and Congressional concern has intensified in recent years as readiness-related funding requests have increased. Defense Authorization Bills now require the DOD to "project the readiness to be obtained during the budget year based on funding proposed in the president's budget [15:6]."

As pointed out earlier by Anthony (4) there is an inability to measure readiness in a common measure of output. This is the major weakness of the UNITREP (1:509). Recognizing this weakness, other systems are under development to supplement UNITREP. Under development are the Air Force Integrated Readiness Measurement System (AFIRMS) and Force Capability Assessment System (FOCAS). AFIRMS attempts to assess and report combat capability at the Air Staff level. With FOCAS, commanders would have the capability to test a war plan for adequacy and make assessments depending upon varying contingencies (1:509-510).

None of the literature indicates that facilities readiness is reported in any fashion under present UNITREP reporting procedures.

> There is no objective way to accurately determine the capability of a given air base to receive and support the forces called for in a plan. Commanders need a 'go no-go' indicator to determine whether or not deployment to a particular base is feasible in the time frame required [1:516].

Existing base comprehensive plans provide a breakout of existing facilities but they are only updated annually and do not exist for some overseas bases. A method is needed for bases to assess their capability and for that information to be passed on to the battle staff commanders (1:516).

Facility Operability

The preceeding analysis of readiness and readiness measurement has built the context in which the term "facility

operability" can be defined. First, an operational definition of facility: the real property, physical plant, structure and related operating systems in support of forces, weapon systems, aircraft or personnel. Facilities have already been described as an object of readiness. Next, an operational definition of readiness:

> Readiness refers to the capability to respond adequately to diverse situations and to sustain that response as long as necessary. The readiness of Defense combat forces depends on a myriad of diverse and often interrelated factors [21:2].

Readiness is a pre-attack assessment of capability.

Survivability is another commonly used term in the readiness arena, and has the following definitions (25:676):

> The measure of the degree to which an item will withstand hostile man-made environment and not suffer abortive impairment of its ability to accomplish its designated mission;
> The capability of a system to avoid or withstand a manmade hostile environment without suffering an abortive impairment of its ability to accomplish its designated mission.

Survivability is a term used in relation to the hostile man-made environment in a post-attack assessment of capability. The Air Force Civil Engineer may manage facilities in a man-made hostile environment or half-way around the world from that environment, and still have significant impact on the accomplishment of a given mission (12:4).

The ability to operate, or the term "operability," is used in this research as a broader term than readiness and survivability and may be used in either the pre-attack or post-attack time frame. In this context operability is

defined as the ability to practically or feasibly accomplish the desired or appropriate military mission.

Tying "operability" to "facilities", facility operability is defined as the ability of a facility to practically or feasibly accomplish the desired or appropriate military mission.

Measuring Facility Operability

AFM 1-1 emphasizes the function of Air Force facilities. Having facilities that are operable is paramount to unit readiness and unit effectiveness, and in turn to force effectiveness.

> The Air Force must have facilities that are properly designed and equipped to support our aerospace warfare systems. They must be designed to function at all levels of conflict and to meet our needs for force reconstitution. Planners must examine our worldwide security and defense commitments, to ensure bases are placed at strategic locations. Forward basing of our tactical and strategic forces enables us to sustain deterrence, assure our territorial integrity, and defend United States and allied lines of communications. It also permits us to project our power worldwide and to exercise leadership responsibilities [21:3-9].

Since the Air Force Civil Engineer's mission is to acquire, construct, operate, and maintain facilities, it follows that CE performance could be measured by assessing the operability of facilities. A measurement of facility operability could be used by CE managers as a tool to manage and control priorities in directing CE work forces. It's use could also extend to developing the budget for operations, maintenance, or new construction needs. By measuring

facility operability a CE manager could assess the current situation, make forecasts of facility readiness and facility survivability (to identify vulnerability) given various wartime scenarios, and plan management strategy from a better informed perspective. This information may also be passed on to the battle staff at Unit, MAJCOM, HQ USAF, and JCS levels.

RESEARCH QUESTIONS

With this basic framework and the definition of the concept of measuring facility operability the following research questions were proposed:

1. Do existing systems for measuring capability, readiness, or effectiveness, have methodologies or elements which lend themselves to being used in or adapted to a system for measuring facility operability?

2. What does the pertinent literature propose for probable wartime scenarios that would be appropriate for use in a system for measuring facility operability?

3. Based on the answers to these research questions, can a model system for measuring facility operability be proposed?

SCOPE OF THE RESEARCH

This thesis is a concept building effort, delving into new frontiers of knowledge (See Figure 2). This thesis

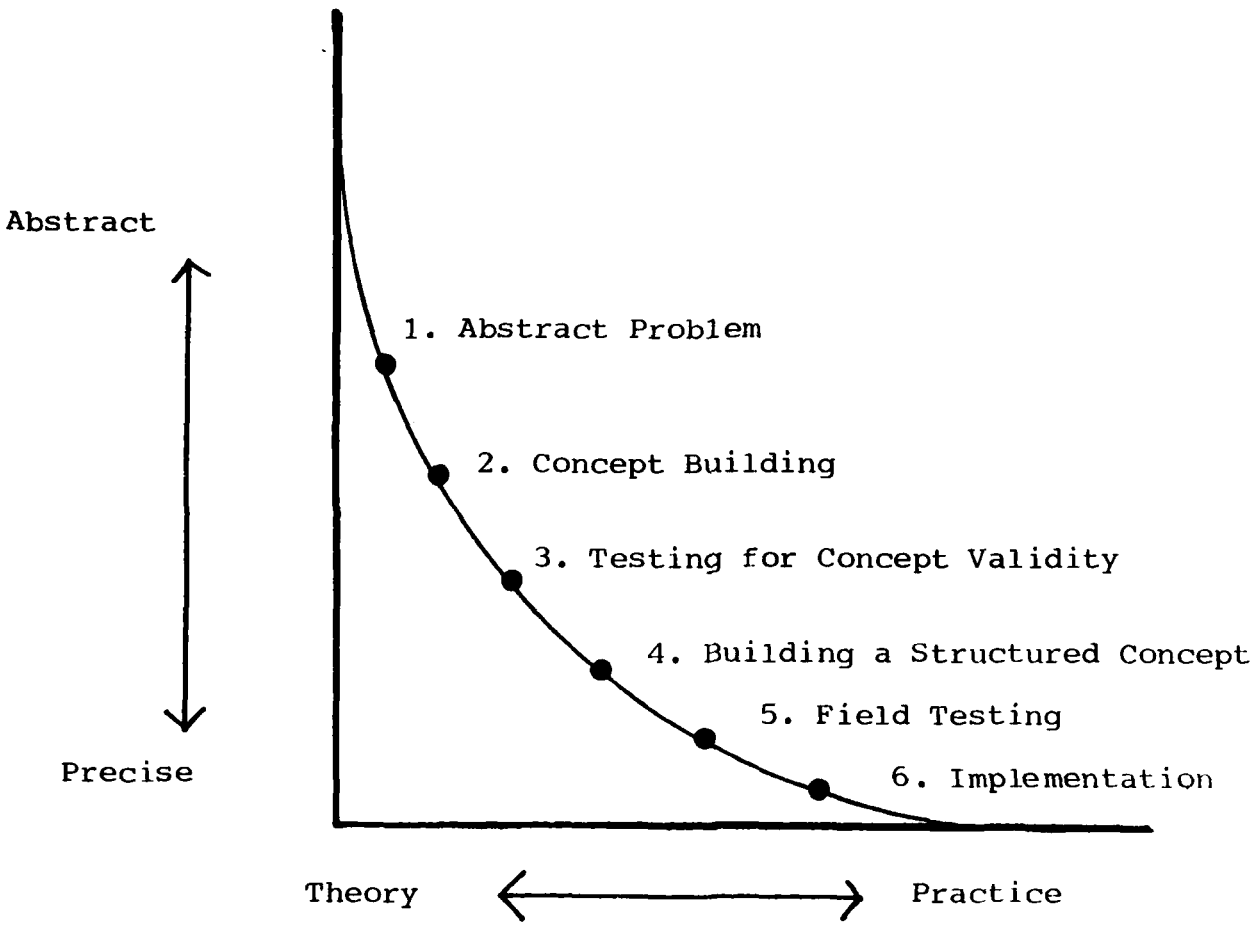

Figure 2

Stages of the Research Process [6:48]

effort was not expected to do a complete cycle of research, which includes the testing of a theory or concept. The research effort concentrated on finding answers to the research questions previously outlined.

Since the research focused on the building of a concept and the development of a model system, no attempt was made to seek classified information. For the purposes of this thesis, general unclassified information was considered adequate. The intent of the model system is to illustrate the concept that facilities affect the capability and readiness of an airbase's military mission.

PLAN OF THE PRESENTATION

The research is presented in a format which follows the basic outline presented by the Research Questions. Chapter 2 includes an examination of four systems. The first two are existing Air Force reporting systems. The third is a newly developed method for measuring organizational effectiveness. The fourth is a land use planning system which provides some innovative decision-making concepts from a non-military perspective. Chapter 3 describes various unclassified wartime operational scenarios. Recommendations are made for their utilization in a system for measuring facility operability. Chapter 4 describes the development of the model system for measuring facility operability. The goals, objectives, functions, and processes

are discussed. The model system for measuring facility operability is described. Chapter 5 gives a summary of findings, presents recommendations for further research, and states the conclusions of the research. One of the basic needs of any planning process is adequate definition of terms (20:5). A compendium of operability related terms is included in Appendix A. Related abbreviations are included in Appendix B. Blank matrix sets are given in Appendix C.

CHAPTER 2

RESEARCH QUESTION 1

Do existing systems for measuring capability, readiness, or effectiveness have methodologies or elements which lend themselves to being used in or adapted to a system for measuring facility operability?

INTRODUCTION

In order to formulate a method of measuring or assessing facility operability, the elements which determine "what is operable or not operable" must be identified. Some elements will be "quantifiably comparable, while others, equally important, are (will be) purely qualitative and judgmental [1:508]."

This chapter contains a review of four systems. The first two, Unit Status and Identity Reporting (UNITREP) System and Aerospace Vehicle and Equipment Inventory, Status, and Utilization Reporting System (AVISURS), are existing Air Force Systems. The third, Analysis of Military Organization Effectiveness (AMORE) is a newly developed method and has had limited testing in the Army and Air Force. The fourth, "City of Logan Guidelines for Development" is a land use planning document which provides some innovative decision making concepts from a non-military perspective.

Each system is described as applicable to measuring facility operability. Specific elements and concepts are drawn from each system which have potential use in the development or application of a facility operability measurement system.

UNITREP

Combat Readiness Reporting

Combat Readiness Reporting, AFR 55-15 (29) describes the Air Force policies, procedures and criteria supporting the Unit Status and Identity Report (UNITREP). Four resource areas are measured, rated, and reported through the UNITREP system: personnel, equipment and supplies on hand, equipment readiness, and training. Unit (Base or Wing) commanders use information from these four areas along with non-measured information to obtain an overall unit C rating. Tradeoffs can be identified between "near-team readiness and the requirements of peacetime operations and force modernization [29:1-1]." Active flying organizations submit UNITREP weekly. Non aircraft units (such as CE) report monthly.

DOC Statement

A formal statement of mission called the Designed Operational Capability (DOC) Statement is developed for each unit by its parent MAJCOM. The DOC outlines "the requirements

on which unit combat readiness is based [29:1-5]." Capability is reported by relating the unit's resources to the unit's primary mission and response time defined by the DOC.

C-Ratings

Combat readiness status ratings are derived from quantitative criteria and defined in qualitative terms. The C-ratings do not provide output capability. They do provide "relative levels of unit combat readiness based on levels of authorized personnel and materiel resources available and training completed [29:2-1]." The five readiness categories are shown in Table 2.

The unit commander's overall C-rating is based on objective and subjective factors. The status of the four resource areas are assessed by an objective "count" of combat essential assets that affect readiness. Each resource area has established criteria to determine the C-status for a given response time. Not all resources which contribute to readiness can be counted and many resources impact the units capability in differing degrees. Subjective factors must be considered when the unit C-rating is assigned. Subjective factors include:

(a) Changes in tasking without necessary changes in resource authorizations, morale, personnel experience, or turnover rates.

(b) Adverse local conditions having an impact on unit readiness.

(c) Absence of critical resources masked by high resource fill rates.

TABLE 2

READINESS CATEGORIES

CODE	DEFINITION
C-1	Fully Combat Ready. A unit possesses the prescribed levels of wartime resources and is trained so that it is capable of performing the wartime mission for which it is organized, designed, or tasked.
C-2	Substantially Combat Ready. A unit has only minor deficiencies in its prescribed levels of wartime resources or training that limit its capability to perform the wartime mission for which it is organized, designed, or tasked.
C-3	Marginally Combat Ready. A unit has major deficiencies in prescribed wartime resources or training that limit its capability to perform the wartime mission for which it is organized, designed, or tasked.
C-4	Not Combat Ready. A unit has major deficiencies in prescribed wartime resources or training and cannot effectively perform the wartime mission for which it is organized, designed, or tasked.
C-5	Service Programmed, Not Combat Ready. A unit that due to service programs, does not possess the prescribed wartime resources or cannot perform the wartime mission for which it is organized, designed, or tasked [29:2-1].

(d) Results of unit readiness exercise, operational readiness or management effectiveness inspections; results of Civil Engineering and Services Management Evaluation Team visits.

(e) Borderline resource fill in several measured areas.

(f) Limits on training facilities.

(g) Critical consumables (such as munitions, POL, etc.) [29:3-1].

Equipment Readiness

The equipment readiness section of UNITREP measures the combat readiness of major equipment (such as aircraft, ICBMs, fire fighting vehicles, or communications vans). Combat ready equipment is ready to perform the unit's wartime mission. A status projection is made of estimated total major equipment items that can be made combat ready within the unit's DOC response time. The basic criteria applied to measuring equipment readiness is shown in Table 3.

Civil Engineering

The Civil Engineering aspect of UNITREP only reports on CE units having Prime BEEF contingency force teams (essentially teams for Rapid Runway Repair) and RED HORSE Squadrons. These reports rate personnel, training, and equipment readiness. The aspect of facilities readiness is not considered.

Facility Operability and UNITREP

Facilities readiness or facility operability considerations are not a part of the existing UNITREP system. However, there are some elements of the UNITREP system which could be transferred to a facility operability measurement or rating system. A facility operability rating system has the potential of being included in the UNITREP system.

DOC Statements. DOC statements established by the MAJCOM could be expanded to include the requirements on

TABLE 3

UNITREP EQUIPMENT READINESS
C-RATING CRITERIA
[29:3-12]

TABLE 3-4

EQUIPMENT READINESS C-RATING CRITERIA

The unit's reported Equipment Readiness C-rating will be the lower of the C-ratings achieved by either A or B; and C	Equipment Category		
	A	B	C
	Total MAJCOM selected combat essential equipment possessed and combat ready divided by the prescribed wartime requirement. (Note 1) (percent)	Aircraft mission ready available divided by prescribed wartime requirement (total PAA). (Note 2) (percent)	MAJCOM selected major end items of equipment possessed and combat ready divided by the prescribed wartime requirements. (percent)
C-1	90-100	75-100	90-100
C-2	70-89	60-74	70-89
C-3	60-69	50-59	60-69
C-4 Note 3	0-59	0-49	0-59

NOTES:

1. Certain major items of equipment with unique capabilities, notably Air Force mobile or transportable communications electronic equipment and navigation aids, do not lend themselves to a percentage measurement. The MAJCOMs will develop supplemental instructions to measure the combat readiness of these items.
2. Full unit authorizations will be used as the wartime requirement unless specifically exempted in this regulation for specific unit kinds and specific missions.
3. An additional rating, C-5, defined as service programmed, not combat ready, is covered in paragraph 2-2e.

which a unit's facility operability is based. Facility operability could be reported by relating the unit's facility resources to the unit's primary mission and the response time defined by the DOC.

A Fifth Resource Area. A fifth resource area of Facility Operability could be added to the UNITREP report as shown in Table 4.

TABLE 4

SUPPLEMENTED UNITREP RESOURCE AREAS

1) Personnel
2) Equipment and supplies on hand
3) Equipment readiness
4) Training
5) Facility operability.

The Facility Operability rating would then impact the overall unit rating.

Combat Readiness Status Ratings can easily be translated into Facility Operability Ratings, or O-ratings as shown in Table 5. Subjective factors would still have to be considered along with the objective factors.

A Facility Operability Section of the UNITREP. A Facility Operability Section of the UNITREP would measure the combat operability of major facilities (such as ready crew, command post, wing headquarters, base operations, etc). A combat operable facility is ready to perform its part in

TABLE 5

FACILITY OPERABILITY RATING CATEGORIES
(adapted from (29:2-1))

CODE	DEFINITION
0-1	Fully Operable. A facility possesses its prescribed levels of resources and performance features and is capable of performing the mission for which it is organized, designed, or tasked.
0-2	Substantially Operable. A facility has only minor deficiencies in its prescribed levels of resources or performance features that limit its capability to perform the mission for which it is organized, designed, or tasked.
0-3	Marginally Operable. A facility has major deficiencies in prescribed resources or performance features that limit its capability to perform the mission for which it is organized, designed, or tasked.
0-4	Not Operable. A facility has major deficiencies in prescribed resources or performance features and cannot effectively perform the wartime mission for which it is organized, designed, or tasked.
0-5	Service Programmed, Not Operable. A facility that due to service programs, does not possess the prescribed resources or performance features or cannot perform the mission for which it is organized, designed, or tasked.

the unit's wartime mission. Facility operability rating criteria could be developed similar to those used for measuring equipment readiness. Performance features could include building elements such as: sheltered openings, mechanical and electrical systems, structural design strength, etc.

AVISURS

Another reporting system from which methodology and criteria can be derived to apply to facility operability is the Aerospace Vehicle and Equipment Inventory, Status, and Utilization Reporting System (AVISURS). The AVISURS is described in AFR 65-110 (27). Rather than reporting readiness, the AVISURS is used to report inventory and utilization of aerospace vehicles and equipment for the purposes of accounting and analyses. AVISURS information is collected at unit level and reported through a Maintenance Management Information and Control System (MMICS) computer or over the AUTODIN to the unit's MAJCOM. MAJCOMs compile and edit the base level reports and forward them to HQ Air Force Logistics Command (AFLC) and HQ USAF. The reports are used at HQ AFLC and HQ USAF as "the basic building block of the Five Year Defense Plan (FYDP) [27:21-]."

Logistics and Vehicle Status Reporting

Logistics status reporting is described in AFR 65-110 (27) and may have considerable application to a

facility operability measurement system. Beginning in paragraph 2-29:

a. The status of each vehicle is based on its ability to fly the unit's missions. The unit's missions are those it must fly to carry out war plans and training requirements.

b. The ability to fly unit missions is measured by the unit's capability to maintain equipment identified on minimum essential subsystems lists (MESL) set up by MAJCOM.

c. For each vehicle with a wartime mission, two equipment lists will be set up for each vehicle.

(1) One will give systems basic to flying a wartime mission.

(2) The second will add those systems for peacetime and training missions.

d. A vehicle may have a condition status as shown below:

(1) Full Mission Capable (FMC). A vehicle must have the systems working to fly all missions under peacetime or wartime conditions.

(2) Partial Mission Capable (PMC). A vehicle must have the systems working to fly at least one wartime mission. Aircraft with no wartime mission must be able to fly any one mission to be in this status.

NOTE: An aircraft on alert may be in this status if it can fly the alert mission. Also, aircraft in precautionary standdown directed by higher authority may be in this category.

(3) Not Mission Capable (NMC). A vehicle cannot fly any wartime mission. An aerospace vehicle with no wartime mission can be NMC if it cannot fly any of its assigned missions.

NOTE: Inspections such as preflight and postflight and actions to prepare for flight such as servicing and drag chute installation are not reported as NMC [27:2-13; 2-14].

Vehicle condition status is further described in paragraph 2-31 and the codes for status reporting are described in paragraph 2-32:

2-31. Logistics Status Classification. A vehicle that cannot fly all of its missions is reported as PMC or NMC. The reason a vehicle is in one of these codes is shown by adding the letter "M" (maintenance), "S" (supply), or "B" (both maintenance and supply) to the basic code. Vehicles in codes NMCM and NMCB also show if the needed maintenance is scheduled or unscheduled.

2-32. Codes for Status Reporting. These codes for status reporting and the criteria for their use are shown below in order of reporting precedence:

a. NMCB Unscheduled. The vehicle cannot fly any of its wartime missions due to lack of parts and repair or reinstallation actions for systems on the MAJCOM basic systems lists. This status condition will also be reported for aircraft without a wartime mission when unable to fly any of its assigned missions.

b. NMCB Scheduled. The vehicle cannot fly any of its missions due to lack of parts for systems on the MAJCOM basic systems lists and scheduled maintenance actions such as an inspection or time compliance technical order (TCTO). This code will be used only when the vehicle cannot be made mission capable within 2 hours.

c. NMCM Unscheduled. The vehicle cannot fly any of its wartime missions due to maintenance for repair or reinstallation of subsystems on the MAJCOM basic systems lists. This status condition will also be reported for aircraft without a wartime mission when unable to fly any of its assigned missions.

d. NMCM Scheduled. The vehicle cannot fly any of its missions due to scheduled maintenance. This code will be used only when the vehicle cannot be made mission capable within 2 hours.

e. NMCS. The vehicle cannot fly any of its wartime missions due to lack of parts for subsystems on the MAJCOM basic systems lists. This status

condition will also be reported for aircraft without a wartime mission when unable to fly any of its assigned missions.

f. PMCB. The vehicle can fly at least one of its missions based on a basic systems list but not all missions due to lack of parts and repair or reinstallation actions for systems on other MESLs.

g. PMCM. The vehicle can fly at least one of its missions based on a basic systems list but not all missions due to repair or reinstallation actions for other systems on the MESLs.

h. PMCS. The vehicle can fly at least one of its missions based on a basic systems list but not all missions due to lack of parts for systems on other MESLs [27:2-14].

How vehicles are classified is shown in a decision flow chart. See Figure 3.

AVISURS and UNITREP

Aircraft status reported through the AVISURS is related to the Equipment Readiness Section of the UNITREP. Wartime conditions for both reporting systems are described by Major Commands in the Designed Operational Capability (DOC) Statement. Aircraft can be evaluated under DOC conditions by Minimum Essential Subsystem List (MESL) and Mission Design Series (MDS). An example is shown in Figure 4. A projection is made when a unit has a stated amount of time to react for a mission. The projection will provide a list of Mission Ready Available (MRA) aircraft according to MESLs assuming a wartime surge maintenance workday and unrestricted use of war reserve materiel (27:2-16).

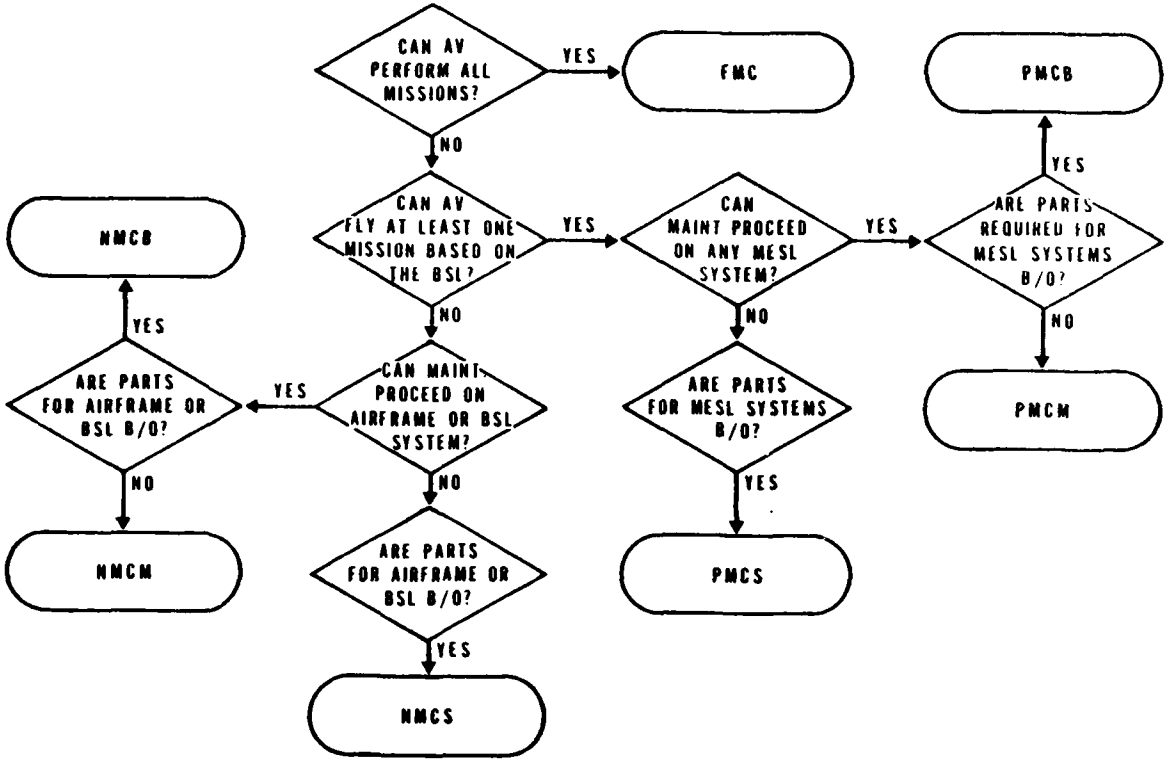

Figure 3

Condition Status Decision Flow [27:2-15]

As of 0400 21 May 79

TAIL NUMBER	65-110 STATUS	5-MIN ALERT MISSION		12-HR AIR SUPERIORITY GENERATION		72-HR AIR TO GROUND GENERATION		WARTIME CONDITIONS ETIC or FDD
		YES	NO	YES	NO	YES	NO	
01	NMCM		x	x		x		0600
02	NMCM		x		x	x		1600/23
03	NMCM		x	x		x		0900
04	NMCB		x		x		x	0800/26 (29 May+12 Hrs
05	NMCM		x	x		x		0500
06	NMCS		x		x	x		22 May + 3 Hrs
07	PMCS		x		x	x		25 May + 10 Hrs
08	PMCS		x		x	x		24 May + 2 Hrs
09	PMCS		x		x	x		31 May + 4 Hrs
10	PMCS		x		x	x		22 May + 1 Hr
11	PMCM		x		x	x		2000/23
12	PMCS		x		x	x		27 May + 4 Hrs
13	PMCS		x		x	x		22 May + 2 Hrs
14	FMC	x		x		x		
15	FMC	x		x		x		
16	FMC		x	x		x		
17	FMC		x	x		x		
18	FMC		x	x		x		

NOTE: Only 50 percent of the aircraft can be equipped with TRAP. This decreases mobility generation capability. Report this to Ops and change availability from 17 to 9 for the air-to-ground mission.

Figure 4

Sample Desired Operational Capabilities Chart [27:2-17].

Facility Operability and AVISURS

Much of the AVISURS nomenclature for equipment and logistics status reporting can be directly adapted to facility operability. MAJCOMS make up the DOC and MESLs for each unit. Facilities could be included in addition to equipment. Once essential facility functions and service systems are identified the terms: Fully Mission Capable (FMC), Partial Mission Capable (PMC), Not Mission Capable (NMC) could apply to a facility's operability. The codes: NMCM (Maintenance), NMCS (Supply) NMCB (Both) would also apply and could be listed as "scheduled" or "unscheduled", just as the equipment codes.

The wartime conditions and time frames described in the DOC would be the same for evaluating facility operability. A list of mission ready available facilities could be generated by a system set up similar to the example shown in Figure 3.

AMORE

Analysis of Military Organization Effectiveness (AMORE) is a newly developed method of assessing unit combat effectiveness and general unit readiness. AMORE considers materiel and personnel counts together against the organization's structure, over time. Treating time as a resource is one of AMORE's unique characteristics. As a unit is

faced with attrition of personnel or equipment, a unit's effectiveness will be determined by its ability to reorganize its remaining resources. "The mere use of attrition counts does not take into account that a unit's effectiveness is not fixed in time [13:32]."

AMORE Elements

The AMORE approach utilizes the following elements:

- Define unit's mission and posture
- Determine the combinations of personnel casualties and materiel damage
- Dissect the unit into its organizational increments and determine which personnel and equipment are essential
- Determine the number of teams that remain operational following an attack
- Determine which personnel and equipment can be substituted to reconstitute a maximum number of essential teams
- Express unit effectiveness in terms of the number of available essential teams as a function of time.

Capability is measured by the number of teams that remain operational after an attack. AMORE can help the commander to restructure essential teams and then minimize the time required to reach maximum capability. A transportation algorithm is used to optimize personnel and materiel assignments according to the commander's objective (13:34-35).

AMORE also gives a measure of a team's resiliency (capability to restructure the team makeup, over time) given varying levels of damage. If capability is shown to be impacted more by personnel than by materiel, the priority should be given to personnel replacements. AMORE identifies personnel skills that should have management priority (13:36).

Facility Operability and AMORE

AMORE was initially tested in Army tank units to measure readiness and sustainability. Air Force application has been in an F-15 squadron, evaluating people and key equipment as they related to tactical air readiness. Good validation was shown for predicting sorties, with a 94% correlation factor (22). Again, facilities were not included as an element of the AMORE system.

Application of AMORE characteristics to a facility operability measurement system might include:

1. Define the facility's mission and posture.

2. Dissect the facility into its organizational elements and systems. Determine which functions are essential to meet the facilities mission in an operable posture.

3. Determine (simulate) combinations of damage, i.e., structural, mechanical, electrical, access, other aspects of the operational system.

4. Determine the equipment or systems that can be repaired or substituted to reconstitute a maximum number of essential functions. (Give response, repair conditions and times).

5. Express facility operability in terms of number of essential functions operational as a function of time.

AMORE would be more nearly complete if it were to incorporate facility operability. Commanders must be concerned with manning key facilities as well as key equipment. Resiliency considerations also apply to facilities. As facility functional systems are damaged, AMORE could prioritize repair according to available materiel, properly equipped and trained civil engineer crews, and facilities priority, as it relates to the unit's mission.

CITY OF LOGAN GUIDELINES FOR DEVELOPMENT

The firm of Maas and Grassli, Landscape Architects and Planners, developed the "City of Logan Guidelines for Development" (20). Their concept of community land use planning provides for:

1. Optimum use of available land resources.

2. Protection of cultural, natural, and historical amenities.

3. Identification of public goals and objectives and the preparation of a plan to achieve them.

Methodology

Of particular interest to a facility operability measurement application is the planning methodology. The Guidelines for Development prescribes a decision making

process for planners and developers to evaluate any land use action proposed on any site in the city. Land use impacts are evaluated through a series of matricies against resource sensitivity, cultural features, natural features, and provides an evaluation of land use desirability (20:2).

Facility Operability and City of Logan Guidelines for Development

A concept of measuring facility operability could include goals:

1. Optimum use of available facility resources.

2. Protection of critical facilities, facility functions, and facility subsystems.

3. Identification of wartime mission goals and objectives and the preparation of a plan to achieve them.

Just as city planners and developers are assisted by a decision making process to evaluate land use desirability, Air Force Civil Engineers and Commanders can be assisted by a decision making process to evaluate facility operability. Facility functions could be evaluated on a matrix system against wartime battle conditions, facility design and construction criteria, and a time resource element, to provide an evaluation of facility operability.

SUMMARY

UNITREP, AVISURS, AMORE, and Logan City Guidelines for Development each have elements which can be transferred

to a method of measuring facility operability. Elements include:

1. The Designed Operational Capability (DOC) statement developed by the MAJCOM describes the wartime mission of a unit and gives specified response times. The DOC statement could be expanded to include: mission posturing of facilities, and their functional priorities, specified response time required for facilities to meet unit response times, and mimumum essential subsystem lists (MESLs) describing priorities of facility subsystems and their minimum essential requirements.

2. Personnel and training needed to be matched with organization and facility function requirements. Resiliency measures could be calculated to adjust for facility or personnel attrition and restructuring.

3. Equipment readiness and supplies on hand could be related to equipment and supplies on hand that are required to meet wartime facility utilization and operability requirements.

4. A list of facility performance features could be developed with such things as building elements, mechanical and electrical systems, structural design strength, etc.

5. Rating Categories could be adopted from UNITREP (29) as shown in Table 5 (page 22) and Table 6 (page 36)

TABLE 6

FACILITY OPERABILITY RATING
CATEGORIES - SUMMARY

CODE	DEFINITION
0-1	Fully Operable
0-2	Substantially Operable
0-3	Marginally Operable
0-4	Not Operable
0-5	Service Programmed, Not Operable

and/or adapted from AVISURS (27) as shown in Table 7.

TABLE 7

FACILITY OPERABILITY RATING
CATEGORIES

CODE	DEFINITION
FMC	Fully Mission Capable
PMC	Partially Mission Capable
PMCM	Partially Mission Capable Maintenance
PMCS	Partially Mission Capable Supply
NMC	Not Mission Capable
NMCM	Not Mission Capable Maintenance
NMCS	Not Mission Capable Supply
NMCB	Not Mission Capable Both Maintenance and Supply
MRA	Mission Ready Available

6. The City of Logan Guidelines (20) offers a development process and a decision making system of matrices which lend themselves to developing a facility operability measurement system.

CHAPTER 3

RESEARCH QUESTION 2

What does the pertinent literature propose for probable wartime scenarios that would be appropriate for use in a system for measuring facility operability?

In attempting to assess the operability of a facility, the conditions under which the facility is expected to operate must be described. Facility operability could be measured under varying conditions associated with certain expected scenarios. A model for measuring facility operability could be developed for each given scenario. The conditions associated with a particular scenario could then be evaluated against the design and construction features of the facilities. Herein lies the potential for commanders and CE managers to assess the likelihood that their facilities would remain operable under ascribed scenarios.

With such as assessment, CE managers would know whether or not their facilities are adequately designed and constructed. If the threat dictates the probability of a particular scenario (or scenarios) certain key facilities may require certain design and construction features. Priorities may be assigned for the renovation of certain facilities to meet specific criteria to withstand the threat of

expected scenarios. New facilities may be required to have certain features or meet specific design criteria.

For the purpose of creating a model system for measuring facility operability an extensive literature search was conducted. Air Force and Army Regulations and Manuals, and defense related technical reports were studied to determine general scenarios and the conditions associated with those scenarios. A general assessment of perceived threat to a United States Air Force Base was sought and not the threat to a specific theater of operations, Major Command, or base.

FINDINGS

There are two aspects to defining a scenario: time frame, and type of conflict.

Time Frame

Scenario time frames are designed to give a baseline when planning for potential crisis or conflict. In a real situation distinct time frames will not exist. An overlapping of scenario time frames will likely occur (21: 10; 12:13-18).

Information in two Air War College reports on readiness planning and readiness measurement (21; 23) suggest four basic time frames:

1) Peacetime day to day operations,

2) Short, highly intense conflict where the outcome is quickly resolved,

3) Short, highly intense conflict followed by sustained operations lasting for weeks or possibly months,

4) Prolonged conflict.

The requirements and the strategy would differ somewhat for each time frame. Security for a prolonged conflict situation compared to a short, intense conflict is dependent on more than the quantity of resources required. By recognizing the need to develop various scenario time frames appropriate strategies can be developed for the construction and use of facilities.

Type of Attack

Depending on the location of the base and political climate of the world, the attacking force could be the Soviet Union, a Third World Nation, Terrorists, or someone else. In lieu of presenting detailed information on military threats and international affairs, this section will focus on the specific types of attack discussed in the current literature.

Air Force Regulation (AFR) 355-1, Disaster Preparedness Planning and Operations (30) identifies three attack scenarios: conventional weapons attack, Chemical-Biological Attack, and Nuclear Attack. Army Field Manual, FM 21-40 (37), on nuclear biological chemical defense indicates that our forces need to be prepared to meet initial or limited attacks involving conventional weapons and the use of chemical and biological agents. The alternate means of attack would involve nuclear, biological, chemical (NBC) warfare (37:1-1, 1-2).

Conventional Weapons. Conventional weapons include weapons such as rockets, torpedos, mines, and bombs, which depend on TNT or other non-nuclear explosive (9:520). Structural damage may be caused by penetration when sufficient thickness is not provided. An air blast created by a near-by exploding weapon can cause damage to a structure (28:12-1). Cratering and fire are secondary effects of conventional weapons.

Chemical Weapons. Chemical weapons are used against personnel or equipment and employ man-made chemicals.

Biological Weapons. Biological weapons used against crops, animals, or man, employ disease producing microorganisms or their by-products. Chemical and Biological weapons are disbursed by airplane spray, bombs, guided missiles, etc. (9: 521). Their effects are transmitted by air vapor or liquid, and are contracted by breathing or skin contact.

Nuclear Weapons. Nuclear weapons, when detonated in the air create an environment of ground and air shock, and nuclear and thermal radiation. A crater will be formed in the earth where the fireball touches. Thermal radiation causes damage to exposed surface layers of material. Exposed flammable material is easily ignited by the heat. Thermal radiation decreases as the distance from the blast increases. Nuclear radiation is of two types. (1) Prompt radiation accompanies the blast. 'Each 18" of concrete or 24" of earth will reduce prompt radiation by a factor of 10

[27:12-4]." (2) Fallout radiation is emitted from the dust particles which settle to the earth hours and days after a nuclear explosion. "Each 9 inches of concrete or 12 inches of earth will reduce this radiation intensity by a factor of 10 [23:12-4]."

Another effect of nuclear weapons is Electromagnetic Pulse (EMP). EMP is a strong electrical discharge resulting from a nuclear-weapon detonation. "Powerful electrical fields affecting large areas of the nation, could result from a high altitude detonation [9:523-524]." Communication systems are especially vulnerable if unprotected from burn-out.

Facility Protection

There are DOD agencies which deal directly and indirectly with weapons effects and protective construction.

The following design and construction criteria, structural features, and protection devices are presented to illustrate some general elements which can be matched to the type of attack. They are intended to increase the chance of survivability and sustain facility operability.

For Conventional Weapons Attack (11; 35).

- protective aircraft shelters
- damage resistant runway covers
- increased redundancy factors for airfield pavements and utility systems
- Rapid Runway Repair (RRR) capability

- rock overlays

- buried reinforced concrete

- camouflage/non-reflective covering

- decoy facilities

- automatic fire suppression system

- etc.

For Chemical-Biological Weapons Attack (19; 35; 37).

- Plastic sheets on hand (to cover equipment)

- Shelters for van and equipment

- Aircraft covers

- communication equipment covers or shelters

- Water - purification capability and sealed containers

- Personnel Decontamination Station (PDS)

  -- Clothing exchange facility

  -- First aid facility

- Facility openings protected from wind

- KMU-450: Fresh air blower unit, installed or mobile

- sealable openings - capability to seal windows, doors, air vents, etc.

For Nuclear Weapons Attack (9; 35; 37).

- Shielding

- core area shelters (protected shelter in center of building)

- overhead roof barriers

- Heavy walls
- Heavy roof
- basement corridors (protected shelters in basement)
- minimize exterior openings at vulnerable locations
- use "substantial" materials in construction (versus lighter counterparts)
- earth berming
- From EMP:
  -- EMP grounding
  -- sealed enclosure
  -- metallic collectors

CHAPTER SUMMARY

Defining multiple scenarios places an increased emphasis on examining facility resources. Additional realism and interaction can stimulate the entire planning process. Specific scenarios will provide planners and Civil Engineers at all levels a systematic structure to focus on the realities of war (23:18).

Appropriate wartime scenarios for use in a general model system for measuring facility operability are:

Types of Attack

1. Conventional weapons attack with Biological-Chemical weapons.
2. Nuclear Weapons attack.

Since Biological-Chemical considerations are included in scenario one, they are not considered again in the second

scenario. The appropriate second scenario would, however, be Nuclear, Biological-Chemical (NBC) weapons attack.

Time Frames

The following scenario time frames were selected to give a baseline when planning for potential crisis or conflict.

1. Short, highly intense conflict where outcome is quickly resolved.

2. Short, highly intense conflict followed by sustained operations lasting for weeks or possibly months.

3. Prolonged conflict.

Facility Protection

A list of general facility design and construction criteria, structural features, and protection devices is given for each type of attack. These criteria, features, and devices are specified to increase the chances of survivability and to sustain facility operability.

Some passive defense measures (33:101) may be added to a facility with relative ease, such as earth berming or rock overlays. Some elements may be added with renovation efforts such as camouflage, sealable openings, adaptability to the KMU-450, increased redundancy factors, etc. Other criteria may need to be incorporated from the design stages of a new project.

Generally for protection to be most effective and least expensive, it must be identified and programmed in the

early design stages of a project. The system for measuring facility operability may not only improve the readiness of our military forces, it may also help save money in life cycle costs of facilities.

CHAPTER 4

RESEARCH QUESTION 3

Based on the answers to Research Questions 1 and 2, can a model system for measuring facility operability be proposed?

THE SYSTEM DEVELOPMENT PROCESS

The first phase in the creation of the Model Facility Operability Measurement System was the identification of goals and objectives for the system.

The System Goals

1) To give battle staff commanders an objective and accurate assessment of a given airbase to receive and support the forces called for in a war plan.

2) To give battle staff commanders a go no-go indicator of the feasibility of deployment to a particular base in a specified time frame.

The Objectives

These objectives were identified to meet the system goals:

1. Give overall base operability rating for given scenario attack conditions and time frames.

2. Give individual facility operability rating for given scenario attack conditions and time frames.

3. Identify key facilities or facility functions and their relative impact on the wartime mission of the base.

4. Identify facility design and construction criteria, structural features and protection devices, for various scenario attack conditions to increase the chance of survivability and sustain facility operability.

Whether or not a facility is operable will generally be dependent on a combination of the following: manpower, training, equipment, or an interrelating element (See Figure 1, page 7). This Model Facility Operability Measurement System focuses on facility operability and does not directly take into consideration the other variables. This system for measuring facility operability is intended to supplement information on manpower, training, equipment, etc., which is available through other information reporting systems.

Formulation of Criteria

The second phase in the creation of the Model Facility Operability Measurement System was the formulation of criteria for decision making. The general method for developing the criteria base is described below.

A. Outline of Planning Tasks.

1. Determine the Designed Operational Capability (DOC) mission.

- Identify facility functions which support DOC.

- Prioritize facility functions to support DOC.

2. Define probable wartime scenario(s).

- Identify attack conditions.

- Identify response time frames.

3. Identify facility design and construction criteria (to protect facilities from scenario conditions).

B. Data Collection. The criteria used to measure facility operability was gathered from the data accumulated while seeking to answer Research Questions 1 and 2. An extensive literature search was conducted. Air Force Regulations and Manuals, Military Journals, periodicals, and reports as well as decision making and planning books and reports were examined.

The criteria lists made from the literature research were only for the purpose of building and illustrating the concept of measuring facility operability. General unclassified information was therefore considered adequate.

C. Planning Tasks for the Model Facility Operability Measurement System.

1. The DOC mission was simply designated as a Tactical Air Command Base "X" in the continental United States (CONUS). Base X supports a Tactical Fighter Wing.

The following is a representative list of facility functions. The facilities are described in decreasing priority as they relate to the DOC mission of the base. It is

not intended to be taken as all-inclusive, but only to illustrate the potential type of facility functions (5).

1) Runway

2) Taxiway and Apron

3) NAVAIDS (TACAN, etc.)

4) Personnel Decontamination Station (PDS)

- Storage facility for chemical warfare equipment and clothing
- Shower, rest, first aid station

5) Rapid Runway Repair (RRR) storage

6) POL (petroleum, oils, lubricants) loading and storage

7) Munitions facility

8) Catapult aircraft barriers (i.e., BAK 9, BAK 13, etc)

9) Squadron Operations

10) Wing Operations - command post

11) Electrical Power Station

12) Electrical Distribution System

13) Water wells, storage

14) Water distribution system

2. One wartime scenario was selected to demonstrate the model system. The type of attack selected was Conventional and Biological-Chemical weapons attack.

Time frames were adapted from an example in the AVISURS (27:2-17) and an Air War College Technical Report (23):

5 minute alert mission

12 hour air to ground generation

72 hour air to ground generation.

7 day short, high intense conflict where outcome is quickly resolved.

15 day short, high intense conflict followed by sustained operations for weeks or possibly months.

60 day to indefinite operations under sustained attack conditions.

3. Facility design and construction criteria, structural features, and protection devices are listed for the given attack conditions to increase the chance of survivability and sustain facility operability. Again, this list is not intended to be all-inclusive, but only to illustrate the potential types of criteria.

1) Airfield Pavements

- Non-reflective or camouflage
- Surface redundancy
- Damage resistant pavements
- "Instant" runways on hand
- RRR kits on hand

2) Utility: Redundancy, hardening, camouflage, decoy

- Storage, purification capability of water system
- Electrical system
- POL storage system
- POL supply system
- Sewer system
- Natural gas system
- Coal
- Compressed air

3) General

- Sheltered construction
- Plastic sheets on hand
- Automatic fire suppression system
- Alarm/alert system
- Sealable openings (ability to seal off doors, windows, ventilation system, etc.)
- KMU-45D Pressure and fresh air unit, (adaptability or installed)
- Semi-hardened construction
- Redundancy of systems
- Decoys
- Non-reflective or camouflage (for roadways, building roofs, windows, etc.)
- Dispersal

SYSTEM DESCRIPTION

A system has been developed to provide a convenient means of storing and evaluating scenario, facility design and construction criteria, and facility function data. The system uses a series of matrices (20) which are used to evaluate a number of different factors at once.

Figure 5 is an overview diagram displaying a simplified form of the Model Facility Operability Measurement System. The system consists of five components matrices, labeled C-1, F-1, O-1, F-2, O-2.

Wartime Scenario I: Conventional Bombing with Biological-Chemical Warfare attack.

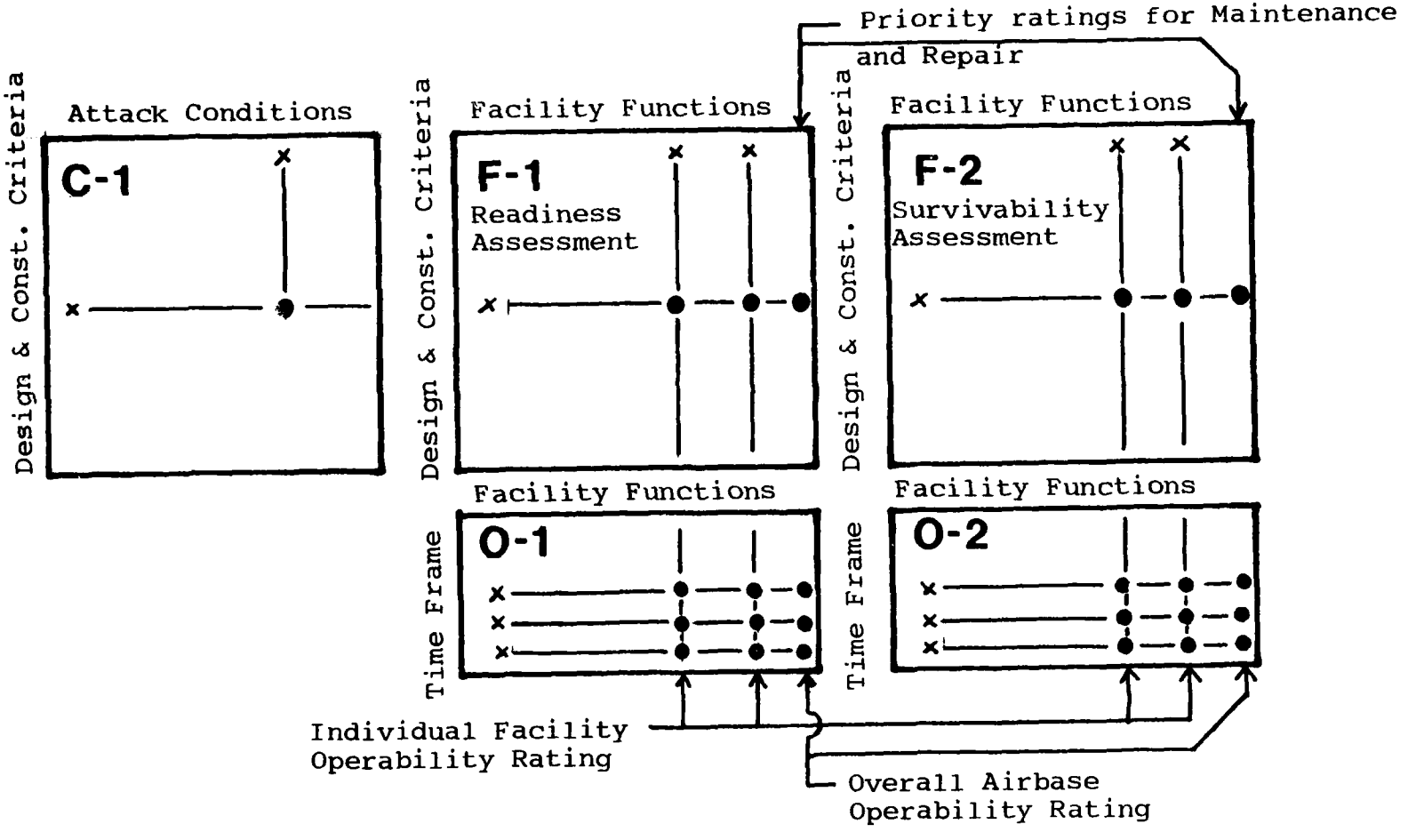

Figure 5

Overview Diagram: Model Facility Operability Measurement System

Matrix C-1

Matrix C-1 relates facility design and construction criteria, vertically to conditions associated with the attack scenario.

Facility Operability is considered in two frame of references.

1. Readiness assessment of operability - frame of reference is the pre-attack condition. Is the facility ready to operate in any of the proposed operational scenarios?

2. Survivability assessment of Operability - frame of reference is the post-attack condition. Did the facility survive the attack--can the manpower, equipment, facilities and interrelated systems operate to perform the DOC mission? (in actual or simulated conditions).

Matrices F-1 and O-1

Matrices F-1 and O-1 work together to give pre-attack, readiness assessments of operability.

Matrices F-2 and O-2

Matrices F-2 and O-2 work together to give a post-attack, survivability assessment of operability (attack conditions could be simulated or real).

F-1 and F-2 Matrices

F-1 and F-2 matrices relate the same facility design and construction criteria on the side to the prioritized list of facility functions along the top. The total range

of impacts on each facility is displayed, showing an indication of the sensitivity of each facility or system to impact. Each intersection box is rated in the top half with an "Importance of Requirement" assessment (how important it that this facility have these design and construction criteria?) of 1 (high) to 4 (low). The lower half of the box is given an "actual operability" assessment (whether or not the designated facility functions can be carried out) of 1 (fully operable) to 4 (not operable). A sub-process to the right of each F matrix gives a priority rating for maintenance and repair. The methodology of this subprocess is shown in Figure 6.

O-1 and O-2 Matrices

O-1 and O-2 Matrices relate the same facility functions from the top to the given scenario time frames to give an individual facility operability rating, codes as shown in Table 8.

The time frame is important in stating facility operability. Long term effectiveness may not be compatible with short term effectiveness, and operability may change over time depending on the function of the various criteria and systems affecting the facility.

The subprocess on matrix O-1 and O-2 gives an overall airbase operability rating, dependent on the operability ratings from each facility function and coded as shown in Table 9.

MAINTENANCE & REPAIR
PRIORITY RATING

"A" Highest

"B" Intermediate

"C" Lowest

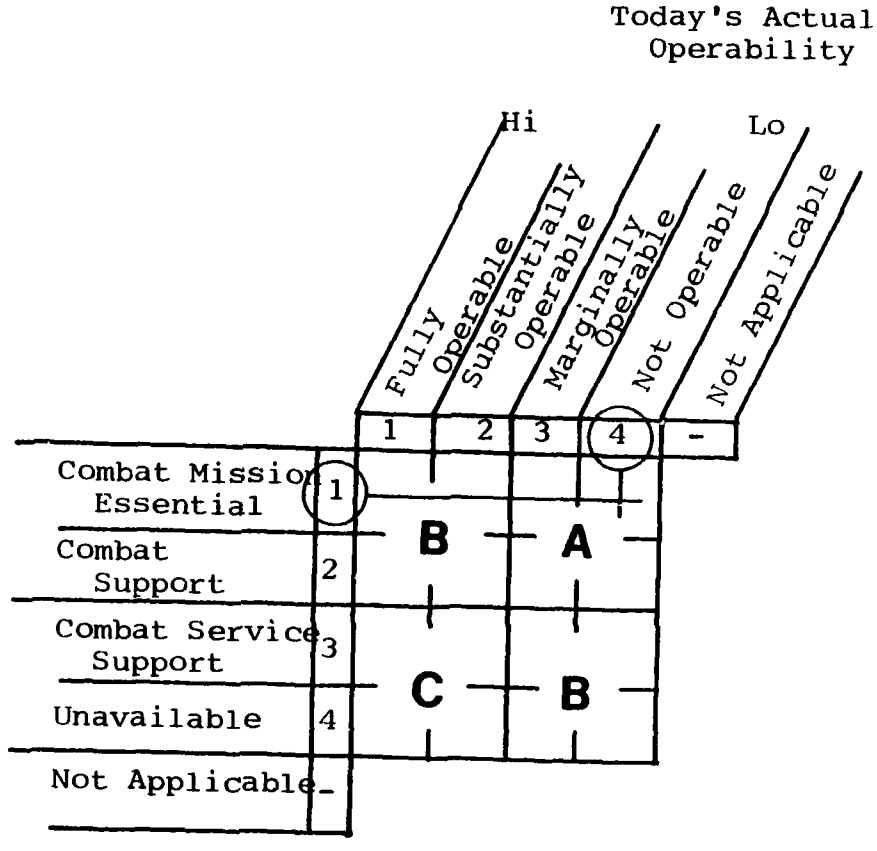

Figure 6

Key for "F" Matrices

TABLE 8

INDIVIDUAL FACILITY OPERABILITY
RATING CODES

CODE	DEFINITION
FMC	Fully mission capable
PMCM	Partially mission capable - maintenance
PMCS	Partially mission capable - supply
PMCB	Partially mission capable - Both M & S
NMCM-S	Not mission capable - Maintenance Scheduled
NMCM-U	Not mission capable - Maintenance Unscheduled
NMCS	Fully mission capable - supply
NMCB-S	Not mission capable Both M & S Scheduled
NMCB-U	Not mission capable Both M & S Unscheduled

The 0-1 through 0-5 airbase operability ratings give a commander the go no-go indicator of the feasibility of deployment to Base X in the specified time frame. The system provides a commander with an objective and accurate (as accurate as the inputs) assessment of the capability of the facilities of base "X" to receive and support the forces called for in a given warplan.

MODEL SYSTEM FOR MEASURING FACILITY OPERABILITY

Matrix by Matrix Description

Figure 7 illustrates how matrices shown in Figures 8 through 15 would be laid out to display data and view relationships.

TABLE 9

OVERALL AIRBASE OPERABILITY RATING
CATEGORIES AND CODES
(adapted from 29:2-1)

CODE	DEFINITION
O-1	Fully Operable. The Airbase possesses its prescribed levels of resources and performance features and is capable of performing the mission for which it is organized, designed, or tasked.
O-2	Substantially Operable. The Airbase has only minor deficiencies in its prescribed levels of resources or performance features that limit its capability to perform the mission for which it is organized, designed, or tasked.
O-3	Marginally Operable. The Airbase has major deficiencies in prescribed resources or performance features that limit its capability to perform the mission for which it is organized, designed, or tasked.
O-4	Not Operable. The Airbase has major deficiencies in prescribed resources or performance features and cannot effectively perform the wartime mission for which it is organized, designed, or tasked.
O-5	Service Programmed, Not Operable. The Airbase that due to service programs, does not possess the prescribed resources or performance features or cannot perform the mission for which it is organized, designed, or tasked.

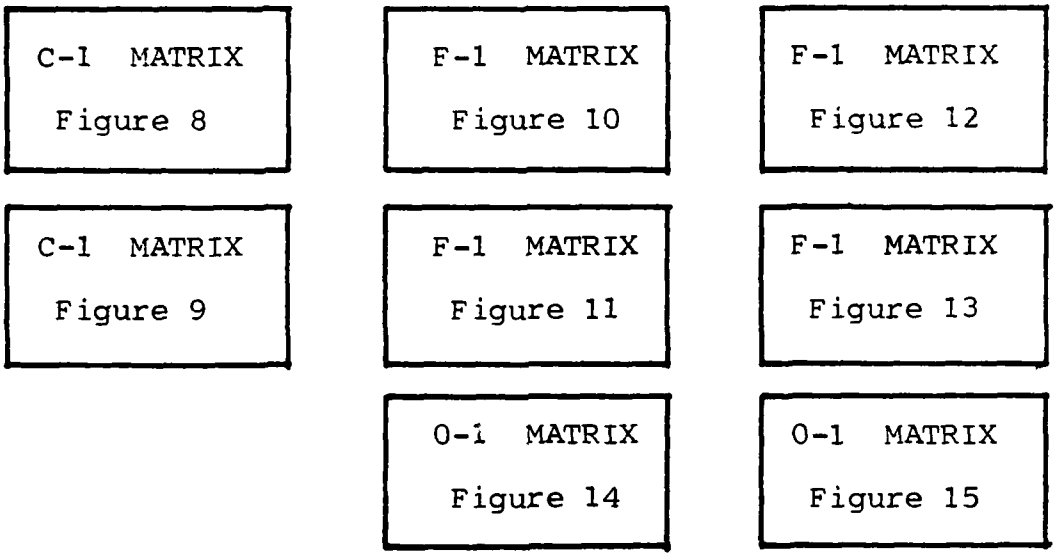

Figure 7

Layout of Matrices: Figures 8 through 15.

The example is intended to focus on the logic and process of the system rather than on the specific items, priorities and ratings indicated.

In this description of the matrices "rows" are referred to as those elements labeled alphabetically and read across, or horizontally. "Columns" are referred to as those elements labeled numerically and read down, or vertically. Individual boxes are referenced by an alpha-numeric indicator such as C:15, or row C = column 15.

C-1 Matrices

Figures 8 and 9 are C-1 matrices. They list facility designs and construction criteria vertically, A through X. Conditions associated with a conventional, Biological-chemical weapons attack are listed horizontally, 1 through 11.

FACILITY DESIGN AND CONSTRUCTION CRITERIA

WARTIME SCENARIO I
CHEMICAL BIOLOGICAL
W/CONV. BOMBS

MATRIX C-1 .

SCENARIO CONDITIONS

CHEM/BIO GAS, VAPOR, LIQUID | CONVENTIONAL BOMB

FACILITY: Redundancy, Decoy, Hardening, Camouflage, AIRFIELD PAVEMENTS		1 Air Contam.	2 Skin Contam.	3 Water Droplets	4 Terrain Contam.	5 Corrosion Effec.	6 Wing Contam.	7	8 Penetration	9 Air Blast	10 Fire	11 Cratering	12	13	14 General Defense	15	
	Non-reflective or Camouflage	A														●	
	Surface Redundancy	B				●				●		●	●			●	
	Damage Resistant Pavements	C								●		●	●			●	
	"Instant" Runways on Hand	D				●							●			●	
	RRR Kits on Hand	E								●			●			●	
	Water System	F	●		●	●	●	●		●	●	●	●			●	
	Electrical System	G					●			●	●	●	●			●	
	POL Supply System	H					●			●	●	●	●			●	
	POL Storage System	I					●			●	●	●	●			●	
	Sewer System	J								●		●	●			●	
	Nat. Gas System	K					●			●	●	●	●			●	
	Coal	L	●		●	●		●		●		●	●			●	

Figure 8

C-1 Matrix: A - L, 1 - 15

WARTIME SCENARIO I
CHEMICAL BIOLOGICAL
W/CONV. BOMBS

MATRIX C-1

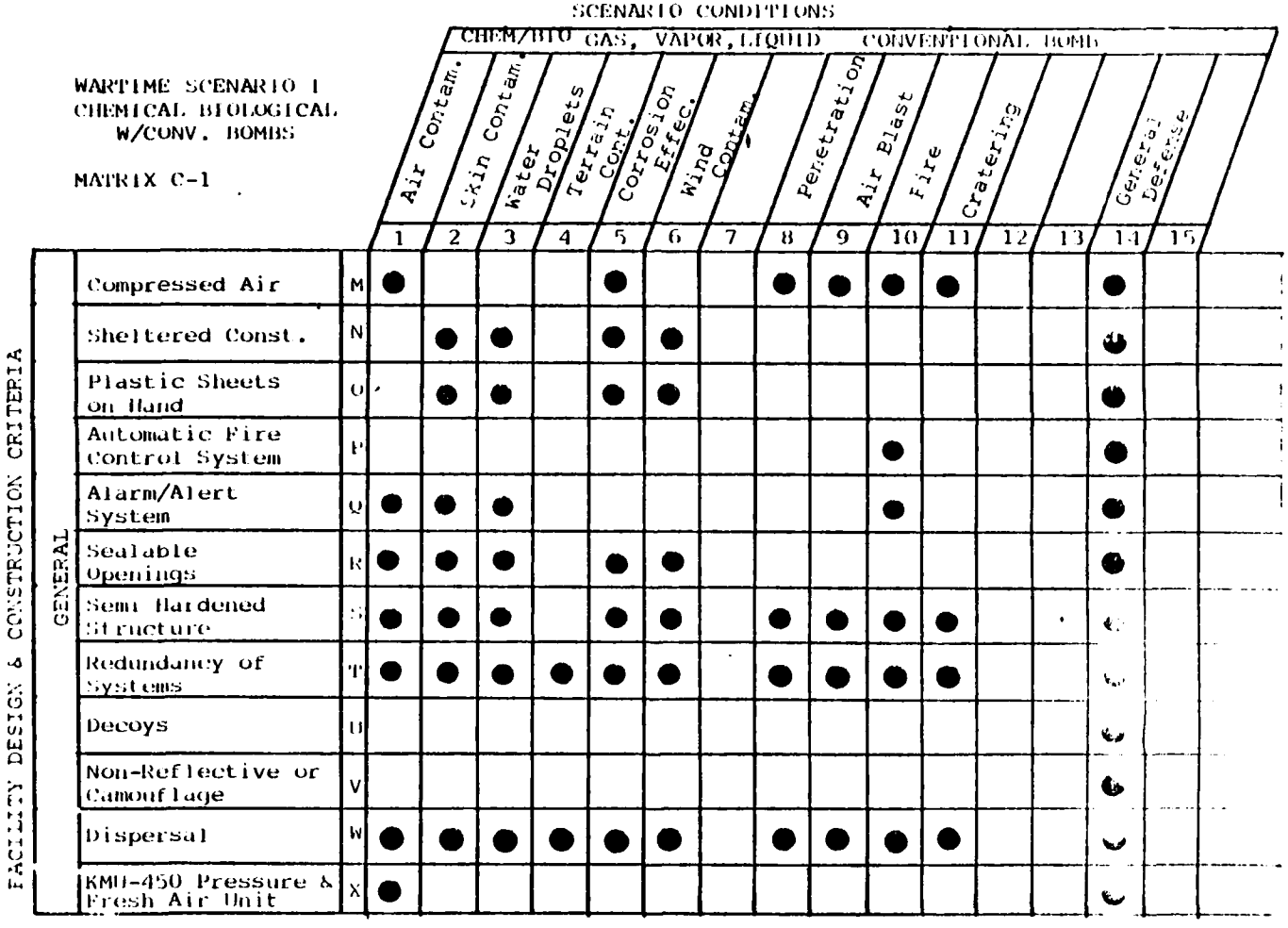

Figure 9

C-1 Matrix: M - X, 1 - 15.

These matrices may be extended vertically or horizontally to accommodate the listing of more criteria or conditions.

Examples:

1) Airfield pavements should be considered for "non-reflective or camouflage treatment" (A). ● in Figure 8A:14 indicates that A is a "general defense" (14) item.

2) The "Water System" (F) (Figure 8) should be considered for redundancy, hardening, camouflaging and/or decoy systems. ● in row F shows that these are "general defense" measures (14), and provide protection against "Air Contamination" (1), "Water Droplets" (3), "Terrain contamination" (4) and so on for conditions 5, 6, 8, 9, 10, and 11.

F-1 Matrices

Figures 10 through 13 are F-1 matrices and would be laid out as shown in Figure 7. Only a readiness assessment of operability in a pre-attack condition is illustrated in this example. F-2 and O-2 matrices for a survivability assessment of operability in a post-attack condition would be filled out using logic similar to that demonstrated in this example of the F-1 and O-1 matrices.

The facility design and construction criteria on the rows of C-1 matrices are repeated on the rows of F-1 matrices. Prioritized facility/facility functions are listed horizontally in columns 1 through 22. Blank spaces are simply an indication that this list is not intended to be an

all-inclusive list and that in this case the facility functions were subjectively prioritized by the author.

Examples:

1) Figure 10, box A:1 indicates the importance of Requirement over actual operability is 2/4.

Non-reflective or camouflage treatment (A) of the runway (1) is considered "2": "Combat Support" in Importance of Requirement rating (See Figure 6). Non-reflective or camouflaged runways are not considered "1": "Combat Mission Essential" since aircraft can still take-off and be recovered. Yet, this criteria contributes significantly to the deterrence of attack, thus is given a rating higher than "3": "Combat Service Support" rating.

Consider in this example that the runway, even with an importance rating of "2" is not non-reflective or camouflaged. This criteria is rated "4": "Not Operable" in the lower portion of the box.

In Figure 12, box A:30, the overall airbase operability rating for non-reflective or camouflaged treatment of Airfield pavements is shown as 2/4. Using the method shown in Figure 6, an "A" priority is given for Maintenance and Repair.

2) Column 30 in Figures 12 and 13 give an overall airbase rating for each row with importance of Requirement over the actual operability rating. Column 31 in Figures 12 and 13 indicates the Maintenance and Repair priority A, B, or C (from method shown in Figure 6).

WARTIME SCENARIO 1
CHEMICAL BIOLOGICAL
W/CONV. BOMBS

MATRIX F-1

Pre-Attack
Readiness Assessment

FACILITY FUNCTION

PDI

FACILITY: Redundancy, Decoy, AIRFIELD PAVEMENTS Hardening, Camouflage		Runway 1	Taxiways Apron 2	NAVAIDS 3	4	C.W. Equip. Clothing Exch. 5	Shower, Rest First Aid 6	RRP Equip. Storage 7	POL Loading 8	9	Munitions Fac. 10	11	Acft. Barr. Bay 5, 13 12	13	Operator Ops. 14	Comm. Center 15
Non-reflective or Camouflage	A	2/4	2/4													
Surface Redundancy	B	2/1	2/1													
Damage Resistant Pavements	C	4/4	4/4													
"Instant" Runways on Hand	D	4/4	4/4													
RRR Kits on Hand	E	1/2	1/2					1/3								
Storage, Purification Water System	F						1/1		3/3		2/3				1/2	1/2
Electrical System	G			1/3		3/3	2/1	3/3	1/3		1/2		1/2		1/2	1/1
POL Supply System	H								1/3							
POL Storage Sys.	I								1/3							
Sewer System	J						1/1		2/2		3/2				2/2	2/2
Nat. Gas System	K										3/2				2/2	2/2
Coal	L										3/3				3/2	3/2

Figure 10

F-1 Matrix: A - L, 1 - 15.

WARTIME SCENARIO I
CHEMICAL BIOLOGICAL
W/CONV. BOMBS

MATRIX F-1

Pre-Attack
Readiness Assessment

FACILITY FUNCTION

PDS

FACILITY DESIGN & CONSTRUCTION CRITERIA			1 Runway	2 Taxiways Apron	3 NAVAIDS	4	5 C.W. Equip. Clothing Ex.	6 Shower, Rest First Aid	7 RRR Equip. Storage	8 POL Loading	9	10 Munitions fac.	11	12 Acft. Barr. BAK 9;13	13	14 Squadron Ops.	15 Comm. Center	
GENERAL	Compressed Air	M										3/2						
	Sheltered Const.	N			2/4		1/1	1/1	1/3	2/1		1/2		1/1		1/2	1/2	
	Plastic Sheets on Hand	O			3/1		1/1		1/1	2/1		2/1						
	Automatic Fire Control System	P								1/1		1/1				1/1	1/1	
	Alarm/Alert System	Q			3/1		2/1	2/1	2/4	1/1		1/1				1/1	1/1	
	Sealable Openings	R					1/1	1/1				1/2				1/2	1/1	
	Semi-Hardened Tructure	S	2/1	2/1			1/1	1/1	3/4	2/4		1/3		1/3		1/2	1/3	
	Redundancy of Systems	T	2/1	2/1	2/4		2/2	2/2	1/4	2/3		1/3		2/2		1/2	1/2	
	Decoys	U	4/4	4/4	2/4		2/1	2/1	3/3	3/4		3/4		2/2		3/4	2/1	
	Non-Reflective or Camouflage	V	2/4	2/4	2/4		2/1	2/1	2/4	2/4		2/4		2/4		2/4	2/4	
	Dispersal	W	4/4	4/4	2/4		2/1	2/1	1/4	3/4				3/2				
	KMU-450 Pressure & Fresh Air Unit	X					1/1	1/1				1/1				1/1	1/1	

Figure 11

F-1 Matrix: M - X, 1 - 15.

WARTIME SCENARIO I
CHEMICAL BIOLOGICAL
W/CONV. BOMBS

MATRIX F-1

Pre-Attack
Readiness Assessment

FACILITY FUNCTION

FACILITY: Redundancy, Decoy, Hardening, Camouflage		Wtg Ops Command Post 16	Photo Interp. 17	18	Electrical Power Sta. 19	Elect. Distr. System 20	Water Wells and Storage 21	Water Dist. System 22	23	24	25	26	27	28	29	Overall Airbase Vulnerability 30	Priority 31
AIRFIELD PAVEMENTS																	
Non-reflective or Camouflage	A															2/4	A
Surface Redundancy	B															2/1	B
Damage Resistant Pavements	C															4/4	B
"Instant" Runways on Hand	D															4/4	B
RRR Kits on Hand	E															1/3	A
Water System Storage, Purific.	F	1/2	1/2				1/2	1/2								1/3	A
Electrical System	G	1/1	1/2		1/2	1/2	1/2									1/3	A
POL Supply Syst.	H															1/3	A
POL Storage Syst.	I															1/3	A
Sewer System	J	2/2	2/.		3/1		3/									2/2	B
Nat. Gas System	K	2/2	2/2													2/2	B
Coal	L	3/2	3/3				3/2									3/3	B

Figure 12

F-1 Matrix: A - L, 16 - 30.

WARTIME SCENARIO I
CHEMICAL BIOLOGICAL
W/CONV. BOMBS

MATRIX F-1

Pre-Attack
Readiness Assessment

FACILITY FUNCTION

FACILITY DESIGN & CONSTRUCTION CRITERIA			Wing Ops Command Post	Photo Interp.		Electrical Power Sta.	Elect. Distr. System	Water Wells & Storage	Water Distr. System								General Airbase Repair	
			16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
GENERAL	Compressed Air	M															3/2	C
	Sheltered Const.	N	1/2	1/2		1/3	1/3	1/4	2/4								1/4	A
	Plastic Sheets on Hand	O				1/1		2/1									1/1	B
	Automatic fire Control System	P	1/1	1/1													1/1	B
	Alarm/Alert System	Q	1/1	1/1		1/1		1/2									1/1	A
	Sealable Openings	R	1/1	1/1				1/3									1/1	A
	Semi Hardened Structure	S	1/2	2/3		2/4		2/4									2/4	A
	Redundancy of Systems	T	1/2	1/3		1/4	1/2	1/2	1/2								1/2	A
	Decoys	U	2/4	2/4		2/4	3/4	3/4									3/4	A
	Non-Reflective or Camouflage	V	2/4	2/4		2/4	2/4	2/4									2/4	A
	Dispersal	W				2/4	2/2	2/2	2/2								1/1	A
	KMU-450 Pressure & Fresh Air Unit	X	1/1	1/1													1/1	A

Figure 13

F-1 Matrix: M - X, 16 - 30.

0-1 Matrices

Figures 14 and 15 would be laid out as shown in Figure 7. The facility/facility functions shown in columns 1 through 22 are the same as shown in the F-1 matrices. Various time frames are indicated in rows A through F in this sample.

Individual facility operability ratings are coded as shown in Table 8, page 57. The overall airbase operability rating is given in column 30 and coded as shown in Table 9, page 58.

Examples:

1) See Figure 14, box A:7, RRR Storage is shown NMCS. The base has no required RRR kits due to a backorder on the supply of RRR kits. Supply is expected to deliver some of the required RRR kits within 60 days but it is expected that some required RRR kits will still be short. Box F:7 is thus shown PMCS.

2) Figure 15, box A:17, is shown PMCM due to the ratings in Table F-1 (Figure 13), see boxes N:17, S:17, T:17, U:17, V:17, and X:17. It is expected that the deficiencies in the facility design and criteria can be upgraded within 60 days by CE Maintenance and repair crews. Thus box F:17 in Figure 15 shows an upgrading to FMC.

3) The overall airbase operability ratings shown in boxes A:30 and F:30 (Figure 15) are both 0-2, substantially operable. RRR Equipment Storage (7) and POL Loading (8)

WARTIME SCENARIO I
CHEMICAL BIOLOGICAL
W/CONV. BOMBS

MATRIX 0-1

Pre-Attack
Readiness Assessment

FACILITY FUNCTION

PDC

TIME FRAME		1 Runway	2 Taxiways Apron	3 NAVAIDS	4	5 C.W. Equip. Clothing Ex.	6 Shower, Test First Aid	7 RRR Equip. Storage	8 POL Loading	9	10 Munitions Fac.	11	12 Acft. Barr. BAK 9;13	13	14 Squadron Ops.	15 Comm. Center
5 Minute Alert Mission	A	FMC	FMC			FMC	FMC	NMC S	PMC B				FMC		FMC	FMC
12 Hour Air Superiority Mission	B															
72 Hour Air to Ground Generation	C															
7-Day	D															
15-Day	E															
60-Day-Indef.	F	FMC	FMC			FMC	FMC	PMC S	PMC B	FMC			FMC		FMC	FMC
	G															
	H															
	I															
	J															
	K															
	L															

Figure 14

0-1 Matrix: A - L, 1 - 15

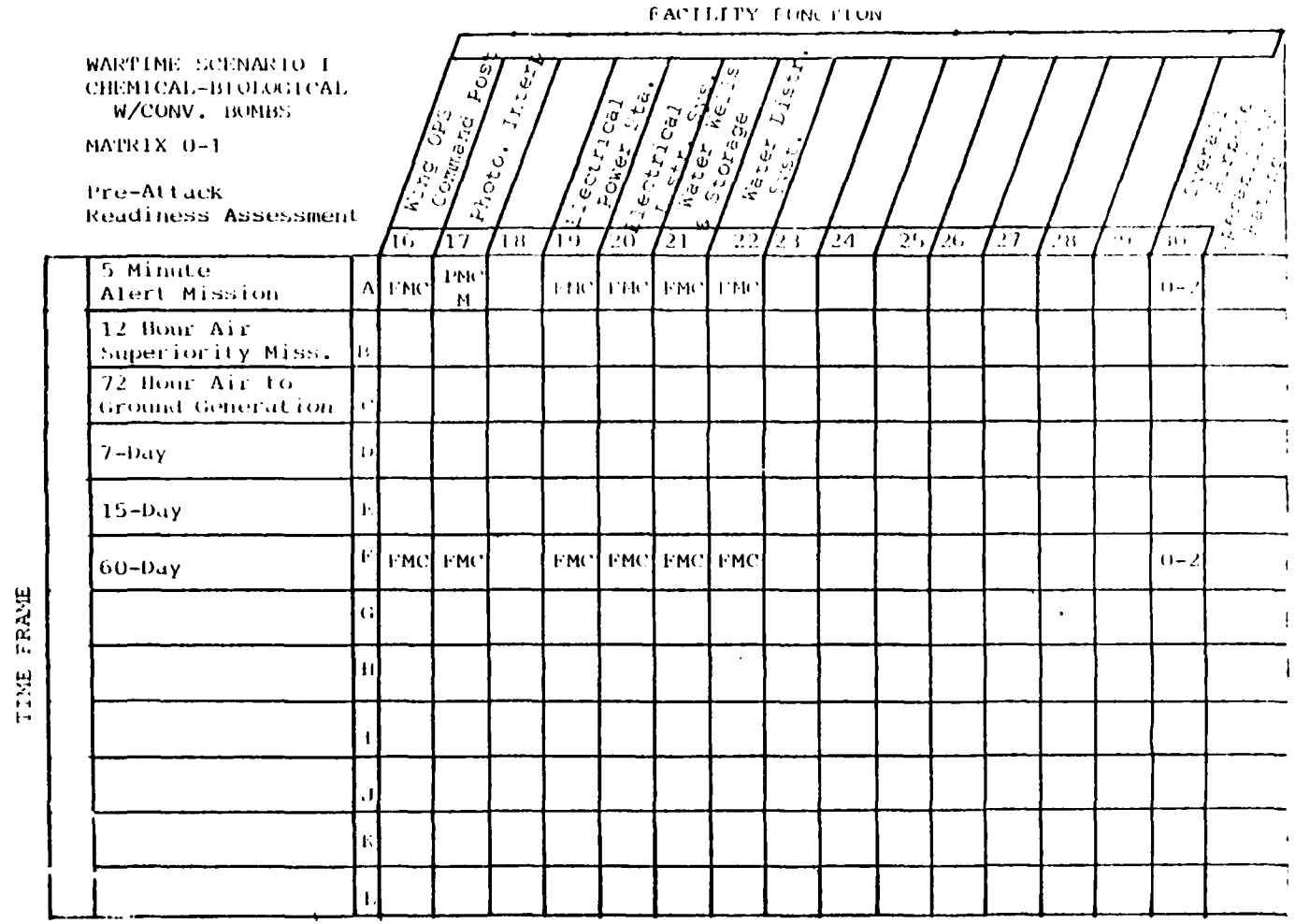

Figure 15

0-1 Matrix: A - L, 16 - 30.

(Figure 14) are shown as Partially Mission Capable which prevents the base from receiving an overall airbase operability rating of O-1, Fully Operable.

CHAPTER 4 SUMMARY

With this model system an objective and accurate assessment can be given for an airbase to receive and support forces called for in a war plan. The overall airbase operability rating serves as a go no-go indicator of the feasibility of deployment to a particular base in a specified time frame. Facility functions are evaluated in measurable factors, subject to limited interpretation. These facility functions in turn relate to a facility operability assessment. For example, if a high priority facility does not meet the specified design and construction criteria of covered entrances for chemical biological warfare conditions, this would show up as a readiness operability deficiency. This along with other deficiencies could then be prioritized and programmed for facility upgrading. A major command may prioritize all deficiencies identified in their command and determine if the scenarios as defined are compatible with their specific mission and current threat assessment, and prioritize their construction projects on their most current criteria.

Each facility function is defined by a set of component criteria and these criteria are each impacted by

conditions dictated by the scenario. The potential impact of a facilities' operability is the total impact of all the component conditions and criteria which relate to the entire base's operability. By understanding the impact of the various facility functions within a given operational scenario, we begin to relate facility operability to an air-base's wartime mission capability in quantifiable, rational terms.

Included in Appendix C are sets of blank matrices which may be reproduced for further studies.

CHAPTER 5

SUMMARY, RECOMMENDATIONS, AND CONCLUSIONS

The Air Force Civil Engineers are responsible for the facilities in support of military forces, weapon systems, aircraft, and personnel. These facilities are a significant element, vitally important to the capability and readiness of our nation's military force. Yet, existing Air Force capability and readiness reporting systems do not call for an assessment of airbase facilities. With this impetus, this study sought to (1) develop the concept that facilities affect the capability and readiness of an airbase's military mission; (2) determine the goals, objectives, and criteria for developing a system to measure the capability and readiness of airbase facilities; and (3) propose a model system for assessing the capability and readiness of facilities as they relate to an airbase's military mission.

Summary

The term "operability" was derived from the definitions of capability, readiness, and survivability. "Facility Operability" was used in the context of measuring the operating capability of facilities as they relate to the military mission of an airbase. Three research questions were formulated to gather and synthesize information.

The first explored the elements and methodologies of existing capability, readiness, and effectiveness measurement systems. The second evaluated probable wartime scenarios and their associated conditions. The third set forth the goals, objectives, and criteria to develop a system for measuring facility operability and a model system was developed.

The Model Facility Operability Measurement System objectively measures how an Air Force installation's facilities contribute to the wartime mission of that base. It gives battle staff commanders an objective and accurate assessment of the facilities of an airbase and their capability to receive and support the forces called for in a warplan. An overall airbase rating is given which provides a go no-go indicator for the feasibility of deployment to a particular base in a specified time frame. This facility operability information can be integrated with other aspects of airbase wartime capability such as personnel, equipment, training, logistics, etc.

Recommendations

The following recommendations have been identified throughout the present research project. The next step in the research process is to evaluate these findings and recommendations to formulate testable, researchable hypotheses and perform test(s) for validation. There may be potential for the involvement of statistical evaluations for the measuring the various operability functions. The Facility

Operability Measurement System would likely lend itself to computerization. A number of other possibilities exist for the development of this concept and further development of the model system. The most prominent recommendations are described below.

Air Staff Sponsored Study. An Air Staff Sponsored Study would serve to focus the concept of measuring facility operability into the formulation of researchable, testable hypotheses. The model system can be refined and tested in a real world, actual airbase situation. This would serve to validate or dispute the concept. Recommendations could then be made for implementation or further revision and testing. The Air Staff Study could explore any of the remaining recommendations.

Management Tool for Civil Engineering Managers. A Facility Operability Measurement System could be used as a management tool for Civil Engineering Managers to manage and control priorities in day to day operations or in wartime situations. Since the system gives a priority rating for Maintenance and Repair work, and minor construction, direction can be given to Civil Engineering work forces. This system can also be used in developing the budget for operations, maintenance, or new construction needs. By measuring Facility Operability a Civil Engineering Manager may assess the current situation, make forecasts of facility readiness and/or facility survivability (to identify vulnerabilities)

given various wartime scenarios, and plan management strategy from a better informed perspective. This information may be passed on to the battle staff at unit, MAJCOM, HQ USAF, or JCS levels.

Damage Assessment Team. Existing procedures call for Civil Engineering support in a post-attack "Damage Assessment Team". Their primary concern is to survey the runway for bomb damage and to spot unexploded ordinance. Their next priority is to assess battle damage of the facilities. By having a system for measuring facility operability, the Damage Assessment Team could radio in information about facilities to the Civil Engineering Command Post. Civil Engineers would collect the information and be able to pass on facility and airbase operability assessments to the battle staff commanders.

Inclusion in the UNITREP. Facilities play a key role in the ability of an airbase to perform its wartime mission. Yet, the requirement to report on the readiness, capability, or operability of airbase facilities does not exist. Civil Engineering units within the Continental United States report only mobility resource requirements. Theater Civil Engineering units only report rapid runway repair (RRR) resource requirements (29:7-1). The assessment of facility operability could be integrated with the existing UNITREP system.

The Major Commands (MAJCOMS) would be the key players in this evolution. MAJCOMS now prepare the Designed

Operational Capability (DOC) statement which designates the requirements upon which the unit's readiness is based for the UNITREP. To include facility operability and airbase operability MAJCOMS would need to develop command specific scenarios, mission posturing of facilities and their functional priorities, specified response time required for facilities to meet unit response times, and minimum essential subsystem lists (MESLs) describing priorities of facility subsystems and their minimum essential requirements.

Personnel and Training could be matched with organization and facility function requirements. Resiliency measures could be calculated to adjust for facility or personnel attrition and restructuring.

Equipment readiness and supplies on hand could be related to equipment and supplies on hand that are required to meet wartime facility utilization and operability requirements.

Empirical surveys of "expert opinion" can be effectively employed in developing the required lists of criteria, function, priorities, etc., required for the system's matrices. The Delphi method (24; 14) is an iterative questionnaire technique applied to a panel of experts. The Crawford Slip Method (8:35-45; 10) is a simple method of gathering a large quantity of ideas in a relatively short amount of time. A combination of these two methods of surveying would assist the MAJCOMs in developing the facilities portion of a DOC.

Aircraft units submit UNITREP data weekly. Non-flying units--such as Civil Engineering, report data once a month. Facility operability data would be reported once a month.

R&D Design and Construction Criteria. The Air Force Engineering and Services Center, Tyndell AFB, Florida; The Airbase Survivability System Management Office, Eglin AFB, Florida; and Research and Development, and Survivability functions at various MAJCOM and other DOD agencies, deal either directly or indirectly with facility design and construction criteria, building and airbase features, and protection devices, for increasing the chance of survival in combat or wartime conditions. These agencies can provide much of the detail and criteria needed to build accurate lists for use on the C-1 and F matrices. The system for measuring facility operability would be a great asset for architects and planners to identify facility functions and see clearly the criteria needed to design more ready, more survivable, more operable facilities.

Air Force Manuals dealing with facility design and planning, particularly, AFM 88-3, Structural Design for Buildings, and AFM 88-15, Air Force Design Manual - Criteria and Standards for Air Force Construction, may need to be supplemented or updated to include more criteria on design and construction for wartime survivability in a peacetime readiness state.

Combat Simulation - Use by ORI, IG, or in Conjunction With FOCAS. For test or inspection purposes such as an Operational Readiness [illegible] ORI) or an Inspector General (IG) visit, a [illegible] evaluated for its survivability operability. Conditions of an operational scenario may be set forth, attack [illegible] may be designated, and a facility operability assessment could be made. Through an attack simulation, facility and airbase vulnerabilities could be identified.

The Force Capability Assessment System (FOCAS) (1:509, 510) described in Chapter 1 is expected to be used by battle-staff commanders to test a warplan for adequacy and make assessments depending upon varying contingencies. The Facility Operability Measurement System could be tested out by FOCAS or a similar combat simulation system. Facility operability would certainly be one of the concerns of commanders as they evaluate war plans.

Conclusions

The result of this research project was the development of a model system for objectively measuring how an Air Force Installation's facilities contribute to the wartime mission of that base. Experimentation and validation of the system was beyond the scope of this research project. The framework and basic methodologies of the concept of measuring facilities operability have been set forth. With further

development of this concept and this system, battle staff commanders could receive an objective and accurate assessment of a given airbase to receive and support the forces called for in a given warplan.

With key facility functions identified and prioritized, even if the physical structure of a facility is damaged, the requirements would be known, which would speed the capability to sustain operability in tents or other make-shift structures.

Facility operability is one aspect of assessing airbase wartime capability. An assessment of facility operability combined with assessments of other elements of our forces such as personnel, weapons systems, training, logistics, etc., will give the commanders of our military defense a more realistic view of our wartime capability. It is hoped that these assessments will help to fulfill the purpose of our military forces identified by William Seago (21:1) in an Army War College Report:

> The primary purpose of military force in peacetime is to be prepared to fight in war. This military preparedness or readiness serves two objectives.
>
> 1. Reduce the likelihood of actually having to fight.
>
> 2. Improve the likelihood of victory if deterrence fails.

AD-A123 741 FACILITY OPERABILITY: ONE ASPECT OF ASSESSING AIRBASE WARTIME CAPABILITY(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF SYST.. G R SUNADA 2/2

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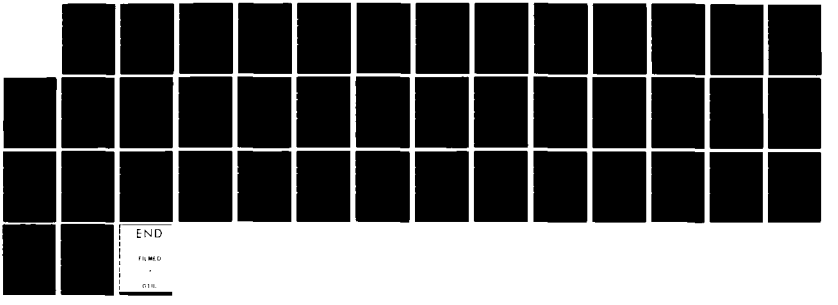

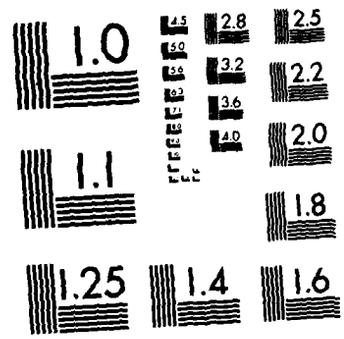

APPENDICES

APPENDIX A

COMPENDIUM OF OPERABILITY RELATED TERMS

Words and terms associated with the concept of operability have been researched in Military and official publications and are assembled here with references to the sources. This compendium of related words and terms provides a resource for improving communications and advancing the concept of measuring facility operability.

Availability (25:81)

Availability is a measure of the degree to which an item is in the operable and committable state at the start of the mission when the mission is called for at an unknown (random) time (inherent availability) (MIL-STD-721B/AR705-50).

Building Systems (31:2-2)

An entire facility made up of subsystems that have a positive interfacing relationship with each other, and that is designed for an effective combination of production, installation, and performance.

C-Day (18)

The unnamed day on which deployment operation commences or is to commence. The highest command or headquarters responsible for coordinating the planning will specify the exact date when plan execution is forecast.

C-rated Mission (18)

The unit's primary wartime mission as stated on the unit's DOC (KF2-A) and for which combat readiness data is reported.

C-rating (29:A-1)

Combat readiness rating.

Capability (25:107-108)

A measure of the ability of an item to achieve mission objectives given the conditions during the mission; the ability to execute a specified course of action; a power or capability to do a particular thing, arising from a feature, condition, faculty, ability, or the like.

Capability Goals (25:108)

System concepts which have the best potential for providing future operational capabilities but which require further advances in technology before a decision can be made on selections for system development and procurement (AF 11-1).

Combat-Essential Equipment (18)

The primary weapon system(s) or service-designated item(s) of equipment assigned to a unit to accomplish its wartime mission.

Combat Readiness Data

All data prescribed by AFR 65-15, attachment 12, (Air Force UNITREP Combat Readiness Data) and JCS Pub 6, Vol II, part 2; chapter 1, section 6 (JCS UNITREP Combat Readiness Data). Combat readiness data is submitted only on the unit's C-rated mission except for the unit's secondary DOCIDs (if assigned by the MAJCOM).

Combat Resource Unit

A combat unit with resources that are measured in UNITREP but reported under the Unit Identification Code (UIC) of another unit.

Combat Service Support (29:A-1)

A military organization that is expected to be in indirect support of a combat organization and planned to be a part of a unified or specific command during combat operations.

Combat Support Elements

Those elements whose primary mission are to provide combat support to the combat forces and which are a part, or prepared to become a part of a theater, command, or task force formed for combat operations (JCS Pub 1).

Deployability Posture (18)

The state or stage of an organization's preparedness for deployment to participate in a military operation defined in five levels, as follows:

1. Normal Deployability Posture -- Organization conducting normal activities. Commanders monitoring the situation in any area of tension and reviewing plans. No visible overt actions being taken to increase deployability posture.

2. Increased Deployability Posture -- Organization is relieved from commitments not pertaining to the mission.

Personnel recalled from training areas, pass, and leave, as required, to meet the deployment schedule. Preparation for deployment of equipment and supplies is initiated. Pre-deployment personnel action completed. Essential equipment and supplies located at CONUS or overseas installation identified. Equipment and accompanying supplies checked, packed, and rigged for deployment, as required, to meet the deployment schedule.

3. Advanced Deployability Posture -- All essential personnel, equipment, and supplies positioned with deploying unit. Unit remains at home station.

4. Marshalled Deployability Posture -- First increment of deploying forces, equipment, and accompanying supplies marshalled at designated POEs but not loaded. Aircraft and ships to transport first increment assembled at POE, but not loaded.

5. Loaded Deployability Posture -- All equipment and accompanying supplies of first increment loaded aboard aircraft and ships and prepared for departure to designated objective area. Personnel prepared for loading on minimum notice.

Deployable Strength (18)

This strength is an organization's present strength, less those personnel ineligible to deploy in an emergency

or crisis situation, based on specific personnel deployment criteria determined in conjunction with the declaration of a deployable alert.

Deployment (18)

In a strategic sense, the relocation of forces to desired areas of operation. (See JCS Pub 1.)

Designed Operational Capability (DOC) Statement (29:1-5)

The mission of the unit being rated will be defined in the unit DOC statement. This formal statement of mission is developed by the unit's parent major command (MAJCOM). It outlines the requirements on which unit combat readiness is based. The unit's primary mission and related resources will be C-rated to satisfy JCS UNITREP. The DOC statement includes adequate amplifying notes or references to documents that identify resources and conditions to be rated in each of the four UNITREP.

DOC Response Time (29:A1-2)

The time period in which a C-rated unit is required to employ or deploy its resources to accomplish the DOC mission.

Effectiveness (25:248)

A measure of the extent to which an item satisfies a set of specific, pre-established requirements. (AR 705-50)

The probability that the material will operate successfully when required. (MIL-STD-721/AFP800-7).

Effectiveness Factors (25:248)

Availability, dependability, and capability and the attendant subdivisions or subroutines including reliability, maintainability, safety, survivability, and vulnerability. (AFSCM 375-5).

Equipment Operationally Ready (18)

Air Force -- The daily projection for equipment of which the status indicates that it is capable of safe use and that mission-essential subsystems, necessary for the performance of the primary missions of the organization to which assigned, are ready. Training is not considered a primary mission for combat and combat support organizations.

Facility

The real property, physical plant, structure and related operating systems in support of forces, weapon systems, aircraft or personnel.

Facility Operability

Facility operability is defined as the ability of a facility to practically or feasibly accomplish the desired or appropriate military mission.

Facility Operability
Rating Categories

0-1 - Fully Operable. A facility possesses its prescribed levels of resources and performance features and is capable of performing the mission for which it is organized, designed, or tasked.

0-2 - Substantially Operable. A facility has only minor deficiencies in its prescribed levels of resources or performance features that limit its capability to perform the mission for which it is organized, designed, or tasked.

0-3 - Marginally Operable. A facility has major deficiencies in prescribed resources or performance features that limit its capability to perform the mission for which it is organized, designed, or tasked.

0-4 - Not Operable. A facility has major deficiencies in prescribed resources or performance features and cannot effectively perform the wartime mission for which it is organized, designed, or tasked.

0-5 - Service Programmed, Not Operable. A facility that due to service programs, does not possess the prescribed resources or performance features or cannot perform the mission for which it is organized, designed, or tasked.

Industrialized Building (31:2-2)

Factory fabricated and assembled system or subsystems which are transported to job site and erected.

Operability

The ability to practically or feasibly accomplish the desired or appropriate military mission.

Operation Plan (18)

As applied to joint operation plan reporting, the term "operation plan" refers to any plan for the conduct of military operations in a hostile environment prepared by the unified and specified commands in response to a requirement established by the Joint Strategic Capabilities Plan (JSCP) or other directive of the Joint Chiefs of Staff, as well as plans prepared by unified commands and DOD agencies to support operations of the unified and specified commands, except for the Single Integrated Operational Plan (SIOP). Operation Plans are prepared in either complete or concept format. An operation plan may be put into effect at a prescribed time, or on signal, and then becomes the operation order.

Operationally Ready (18)

1. As applied to an organization, ship, or weapon system -- Capable of performing the missions or functions for which organized or designed. Incorporates both equipment readiness and personnel readiness.

2. As applied to equipment -- Available and in condition for serving the functions for which designed.

3. As applied to personnel -- Available and qualified to perform assigned missions or functions.

Plan (25:523)

A proposed method for accomplishing a mission or reaching an objective. It implies use of imaginative scope and vision and mental formulation of ideas and [illegible] - fined state a plan becomes a detailed documentation of necessary actions for the accomplishment of an objective. Functional planning is performed by all AFLC organizations while corporate planning is the responsibility of the DCS/ Plans and Programs (XR). (AFLCR 400-9).

Planning (25:523)

The process of determining what actions or capabilities are needed to accomplish a mission (NAVMAT P-4215).

Entails the systematic application of engineering/ production techniques to determine processing methods to be employed; the requirement for manpower, equipment, tools, materials, etc., to produce a given quantity of products or services in a timely manner, within specified quality limits, and a competitive cost. (AFLCR 66-4).

Readiness (16:1182)

The quality or state of being prepared or equipped to act or be used immediately.

Readiness (32:3-3)

Readiness is a condition resulting from training and posturing forces so that aerospace power can be brought rapidly to bear anywhere in the world. Readiness prepares the Air Force to perform its missions quickly.

Readiness (21:2)

Readiness refers to the capability to respond adequately to diverse situations and to sustain that response as long as necessary. The readiness of Defense combat forces depends on a myriad of diverse and often interrelated factors.

Readiness

Readiness is a pre-attack assessment of capability as opposed to survivability, which is a post-attack assessment.

Readiness Rating Limitation (18)

Air Force -- The highest rating of composite readiness that an organization can be expected to attain due to a limitation imposed by higher authority.

Relocatability (31:2-2)

The ability to economically dismantle, transport to a new location, and re-erect a total facility or significant portion of a facility.

Required Operational Capability (ROC) (25:588)

A formal serially numbered document giving a general description of operational capabilities deemed necessary at a specific time in the future, outlining the capability desired rather than the means of accomplishment, describing

the objective, operational concept, expected operational environment, and other pertinent factors to be considered. (AFM 11-1).

Subsystems (31:2-2)

A combination of parts or components which are designed, produced, installed, and intended to achieve a coordinated, integrated, and efficient functional assembly. These subsystems are not necessarily based on trade divisions.

Support System (25:674)

A composite of equipment, skills, and techniques which, while not an instrument of combat, is capable of performing a clearly defined function in support of an Air Force mission. A complete system includes all subsystems, related facilities, equipment, material, services, and personnel required to be considered a self-sufficient unit in its intended operational environment. Support may be furnished by such a system to operating or support forces, weapon systems, command and control systems, or to other support systems. (AFM 11-1).

Supportability (25:674)

That characteristic of a material which quantifies its ability to adapt to changing supply and maintenance concepts. (AR 705-50).

Survivability (25:676)

The measure of the degree to which an item will withstand hostile man-made environment and not suffer abortive impairment of its ability to accomplish its designated mission;

The capability of a system to avoid or withstand a manmade hostile environment without suffering an abortive impairment of its ability to accomplish its designated mission.

Survivability is a term used in relation to the hostile manmade environment in a post-attack assessment of capability.

Survivability Master Plan (25:676)

Denotes a plan for implementing survivability/vulnerability requirements. (AFM 11-1).

Survivability Requirements (25:677)

The specific design requirements and system characteristics included in the system specifications which provide the level of desired survival capabilities established for USAF systems and equipment in the appropriate ROC and PMD [Program Management Directive(s)]. These requirements include capabilities such as countermeasures, hardness, infrared suppression, reduction of radar cross section, electronic emissions. (AFR 80-38).

Tasked Deployable/Employable Strength (18)

The number of personnel an organization is required to deploy/employ by the Unit Type Code (UTC) tasked to the organization, as identified in an operational plan/order, to meet mission requirements in a specific emergency or crisis.

Total Personnel Required (Mobility DOC) (29:A1-4)

The total personnel required by the reporting unit's UTC packages.

UTC - Unit Type Code

UNITREP C-rated Unit

Those units designated in paragraph 1-9 and classified as combat, combat support, or combat service support by the Unit Status and Identity Report's (UNITREP's) Unit Description Code (UDC).

Wartime Resources (18)

Personnel, equipment, and supply organic assets required to accomplish a unit's wartime mission.

Wartime Table of Organization Document (18)

The Service document that specifies the personnel requirements to accomplish a unit's wartime mission, specifically: US Air Force -- the strength required by the unit type code (UTC) packages specified in the USAF Manpower

Force Packaging System (MANFOR) will be used by those units organized primarily for deployment as the initial phase of their wartime mission. Those units organized primarily to perform their wartime mission in-place will use the strength authorized by the proper Unit Manpower Documents (UMDs).

Worldwide Military Command and Control System (WWMCCS) (18)

The WWMCCS consists of the facilities, equipment, communications, procedures, and personnel that provide the technical and operational support involved in the function of command and control of US military forces. The system is comprised of:

1. The National Military Command System (NMCS).

2. The subsystems of the commanders of unified and specified commands.

3. The subsystems of the Service headquarters.

4. The subsystems of the commanders of component commands.

5. Those elements of the subsystems of other DOD agencies and offices which directly support the command and control functions; e.g., DNA, DIA, and DCA.

APPENDIX B

ABBREVIATIONS

AFIRMs -- Air Force Integrated Readiness Measurement System.

AFM -- Air Force Manual

AFR -- Air Force Regulation

AMORE -- Analysis of Military Organizational Effectiveness

AUTODIN -- Automatic Digital Network

AVISURS -- Aerospace Vehicle and equipment Inventory, Status, and Utilization Reporting System.

CE -- Civil Engineering

CONUS -- Continental United States

DOC -- Designed Operational Capability

DOD -- Department of Defense

FOCAS -- Force Capability Assessment System

FORSTAT -- Force Status and Identity Report

FMC -- Fully Mission Capable

JCS -- Joint Chiefs of Staff

MAJCOM -- Major Command

MESL -- Minimum Essential Subsystem List

NMC -- Not Mission Capable

NMCB -- Not Mission Capable, Both (maintenance and supply)

NMCM -- Not Mission Capable, Maintenance

NMCS -- Not Mission Capable, Supply

PMC -- Partially Mission Capable

PMCB -- Partially Mission Capable, Both (maintenance and supply)

PMCM -- Partially Mission Capable, Maintenance

PMCS -- Partially Mission Capable, Supply

RRR -- Rapid Runway Repair

TRAP -- Tanks, Racks, Adapters, and Pylons

UCMS -- Unit Capability Measurement System

UNITREP -- Unit Status and Identity Report

WRM -- War Reserve Materiel

APPENDIX C

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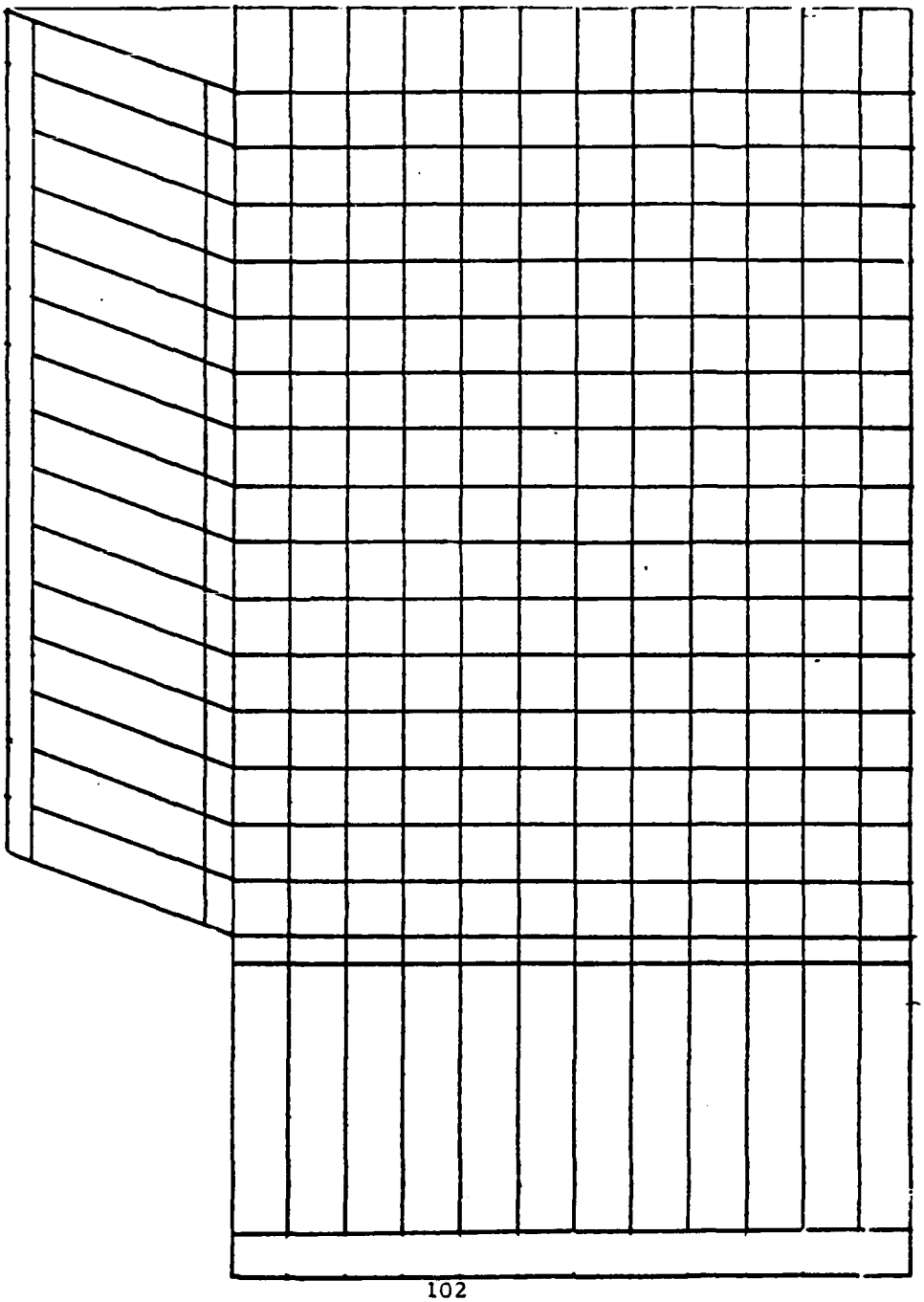
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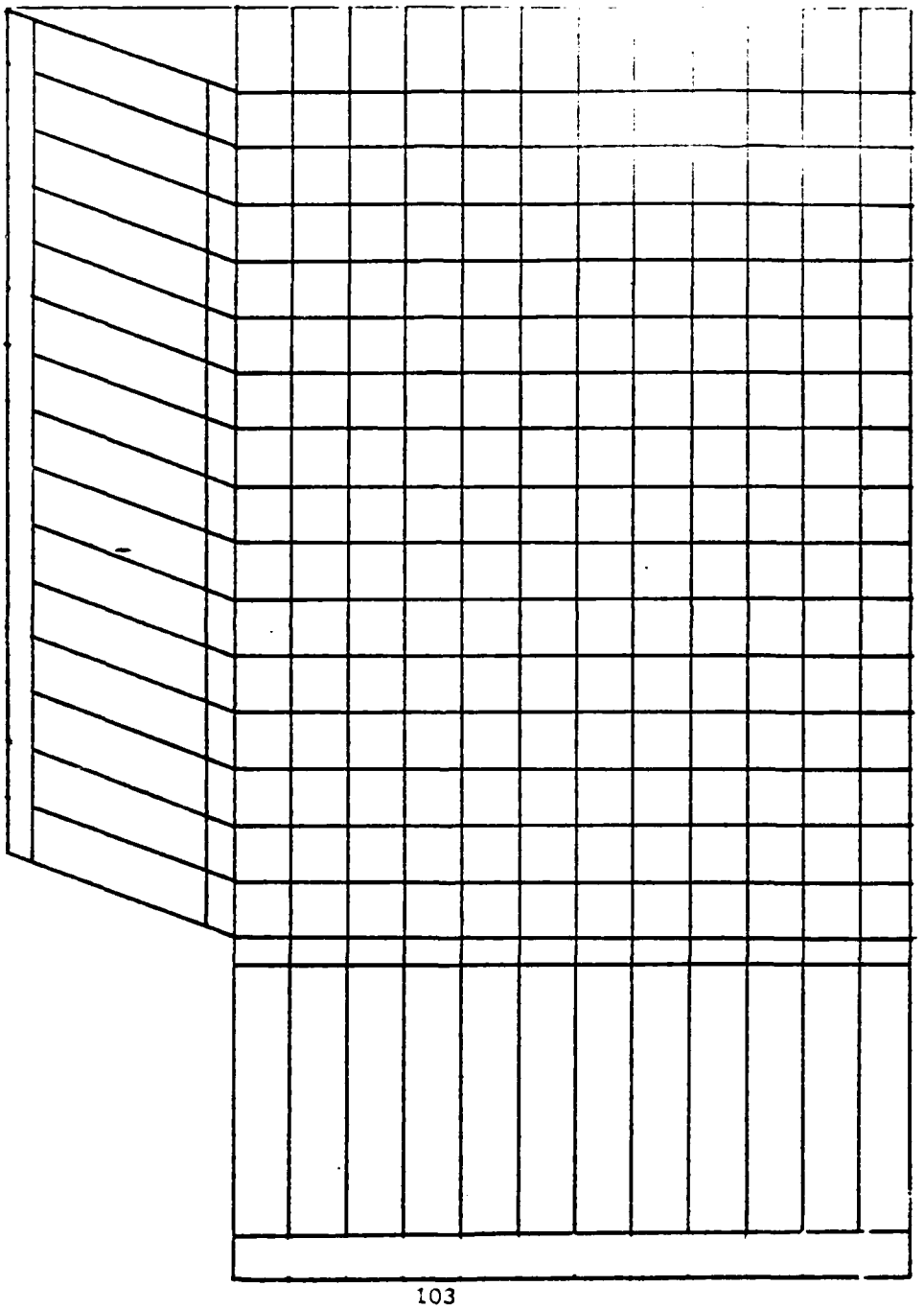

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W/CONV. BOMBS

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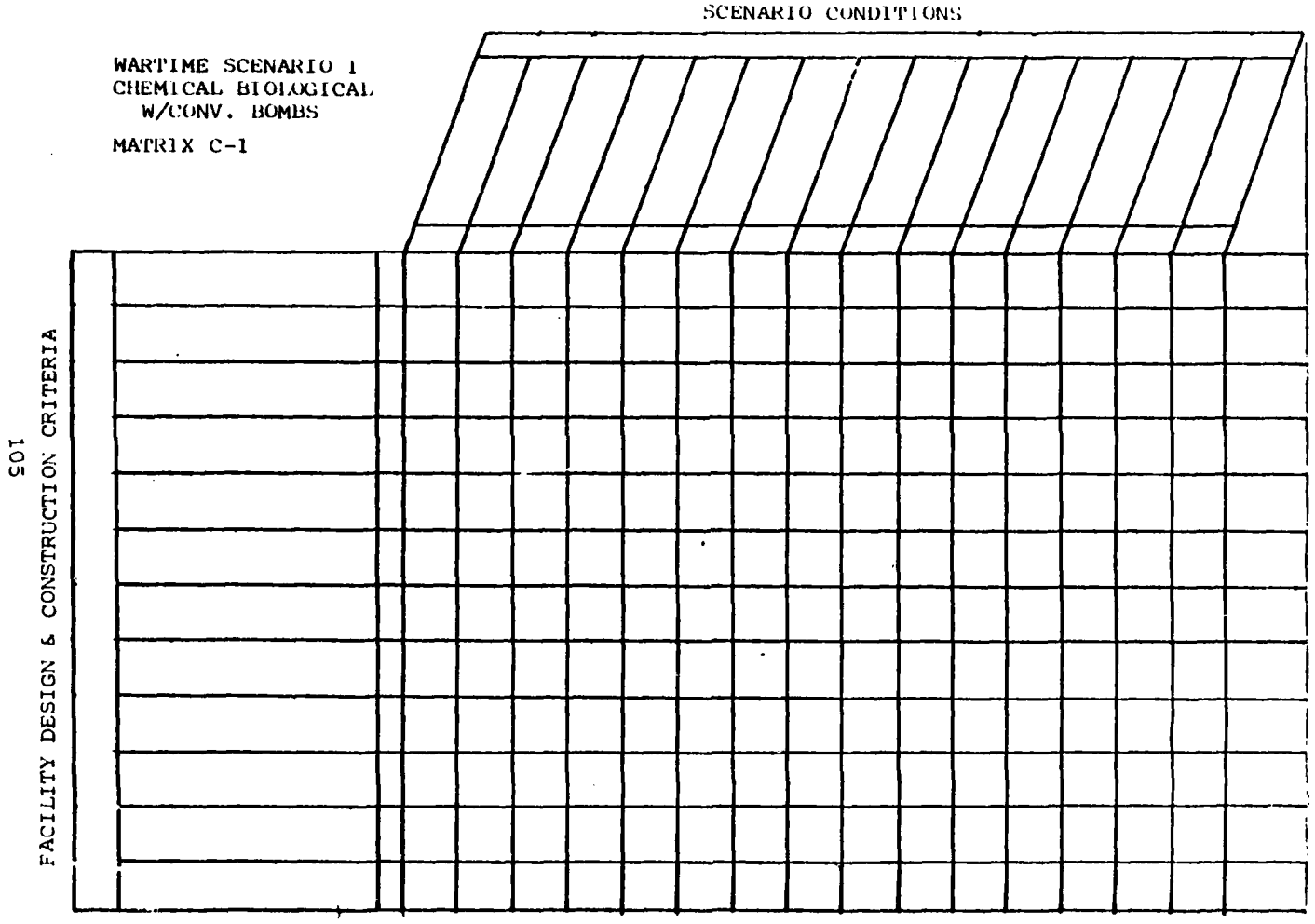

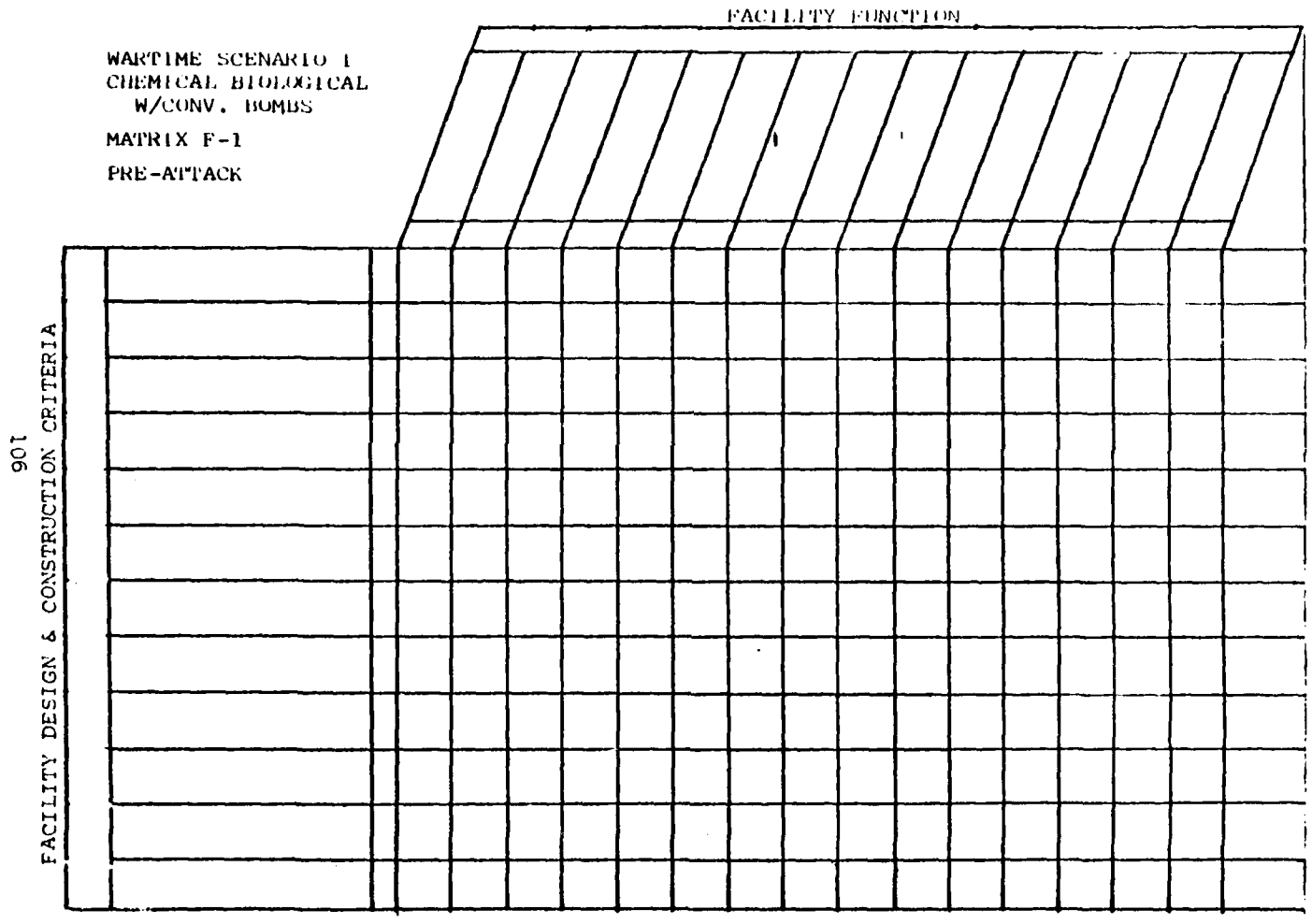
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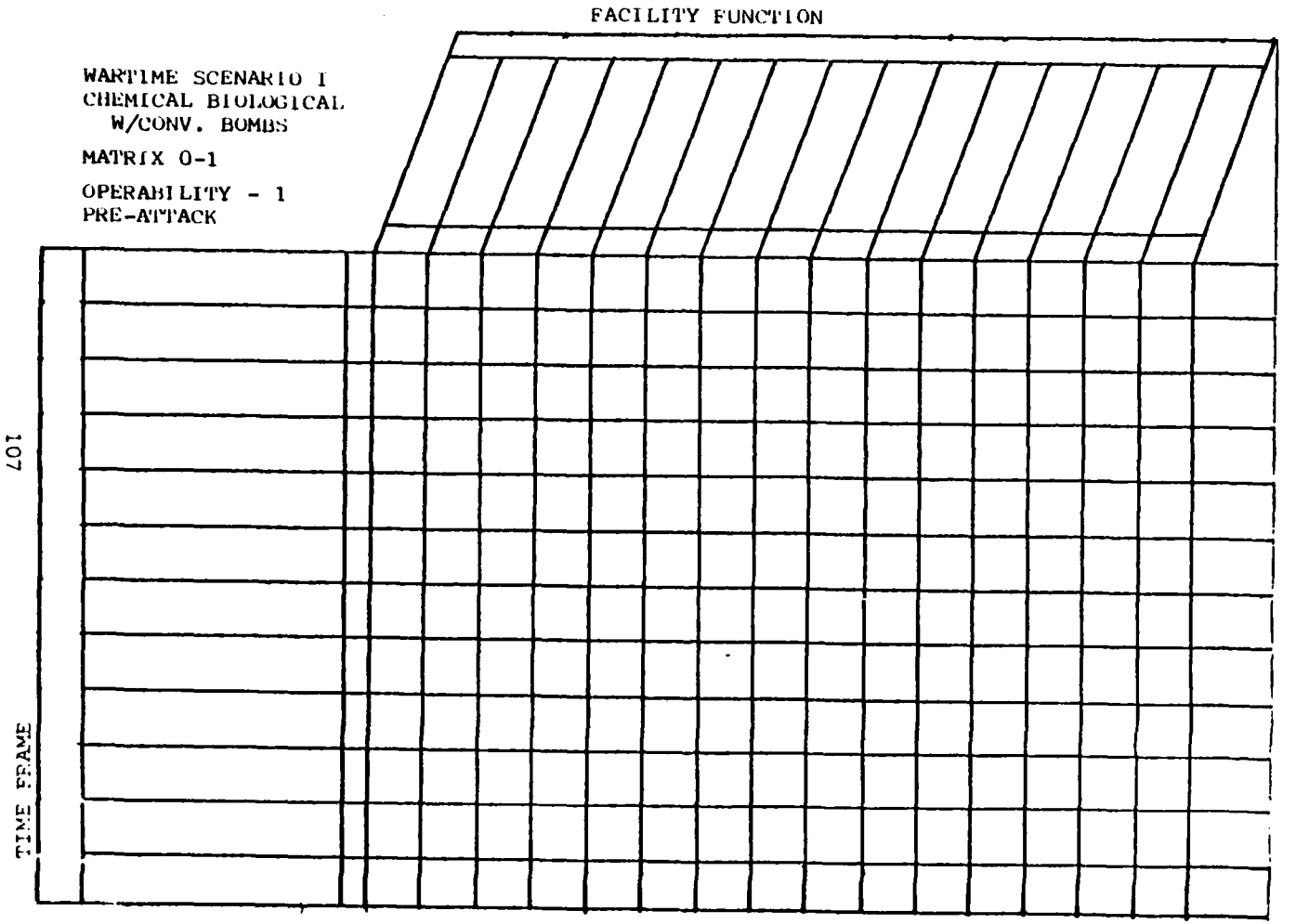
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CHEMICAL BIOLOGICAL
W/CONV. BOMBS
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OPERABILITY - 1
PRE-ATTACK
TIME FRAME
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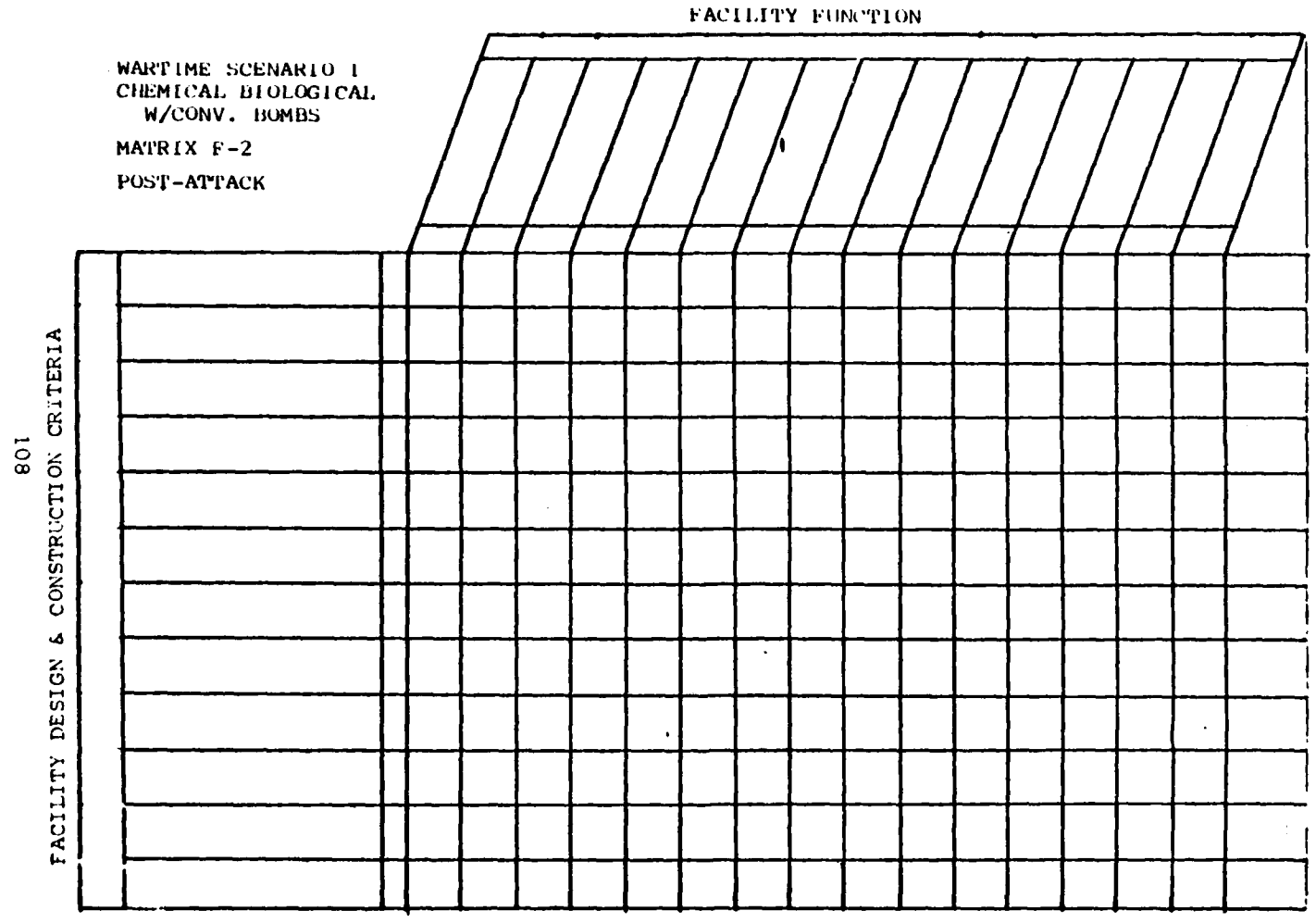
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POST-ATTACK
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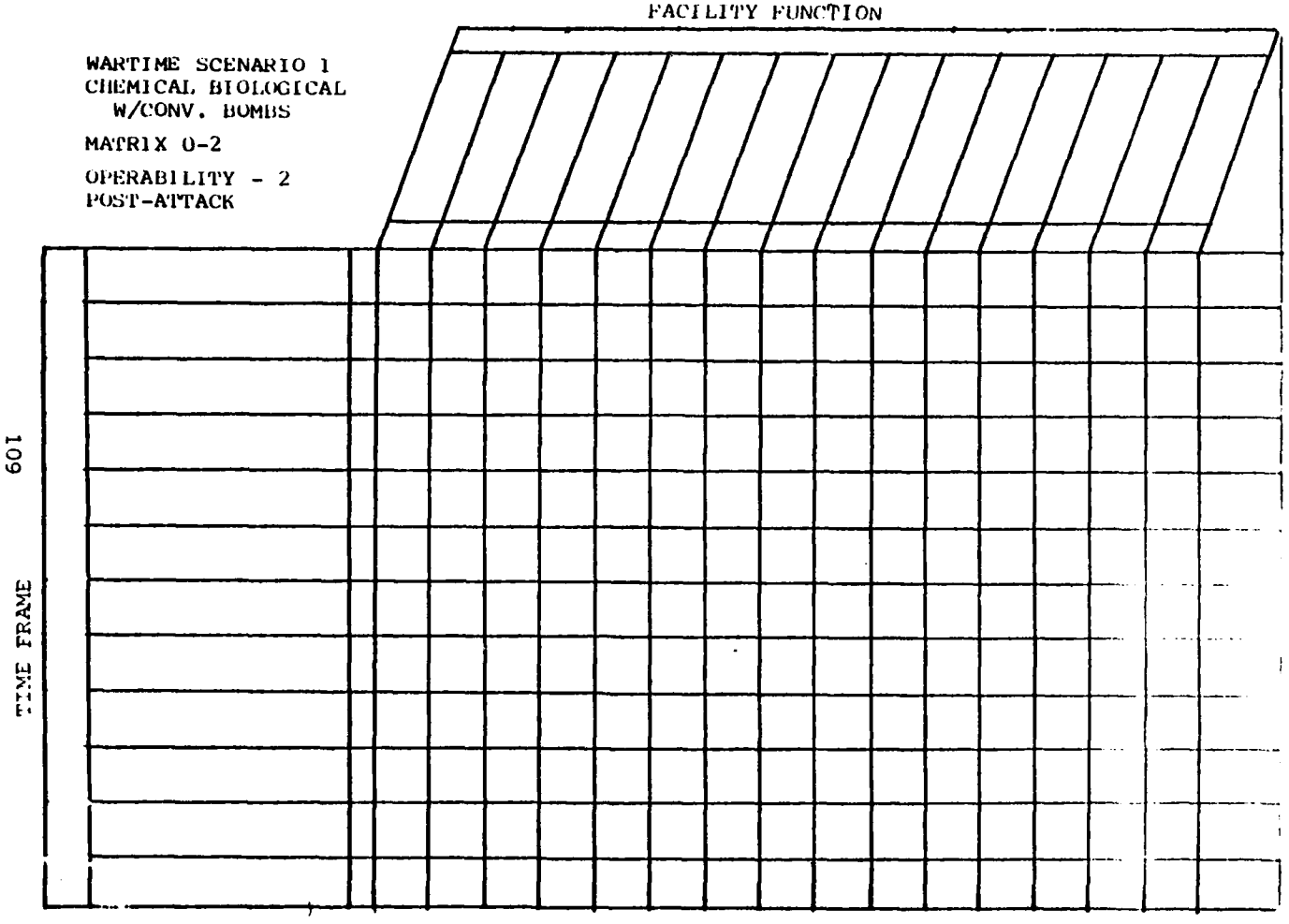
FACILITY DESIGN & CONSTRUCTION CRITERIA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MATRIX 0-2
OPERABILITY - 2
POST-ATTACK
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TIME FRAME

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MATRIX SET
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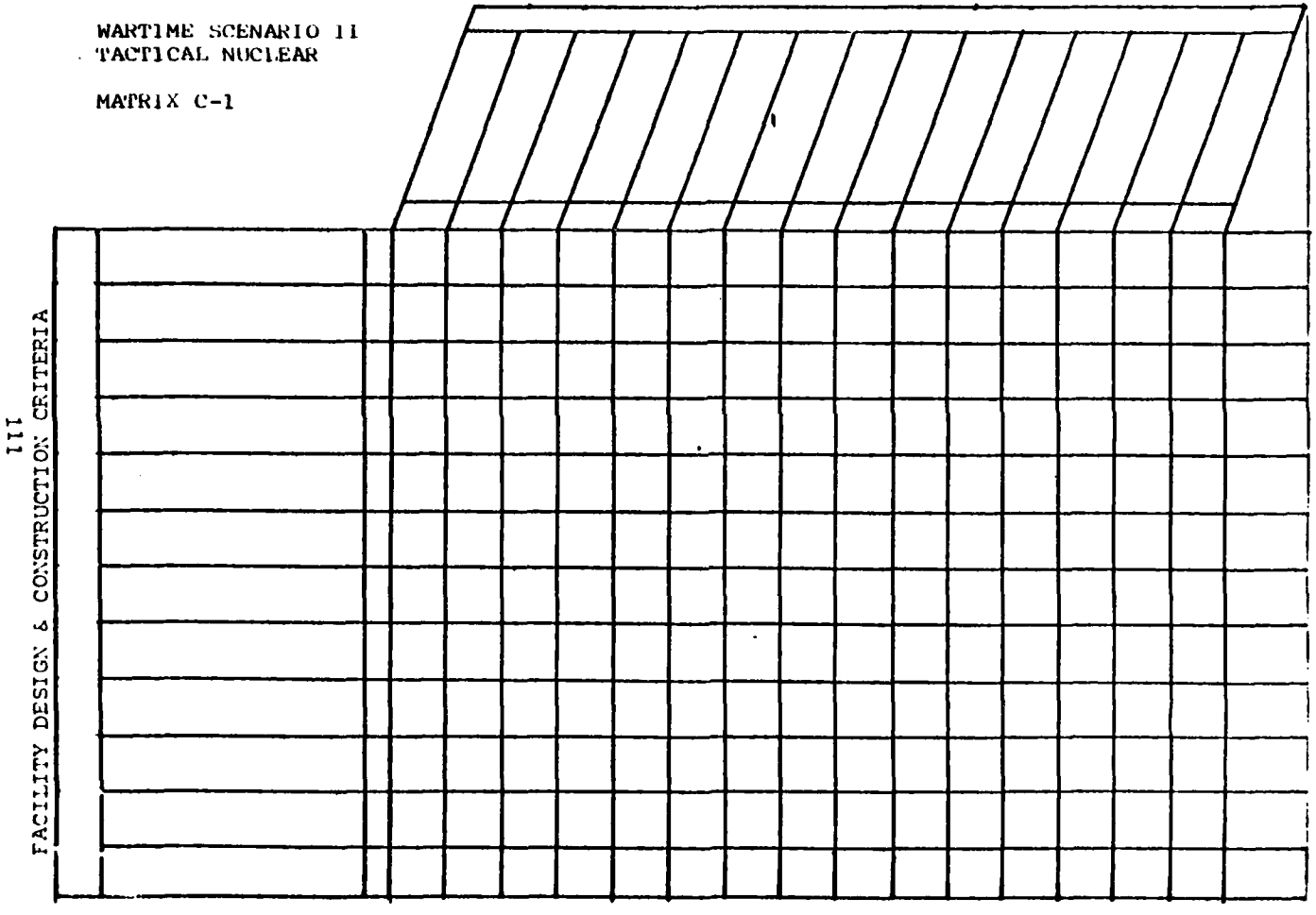
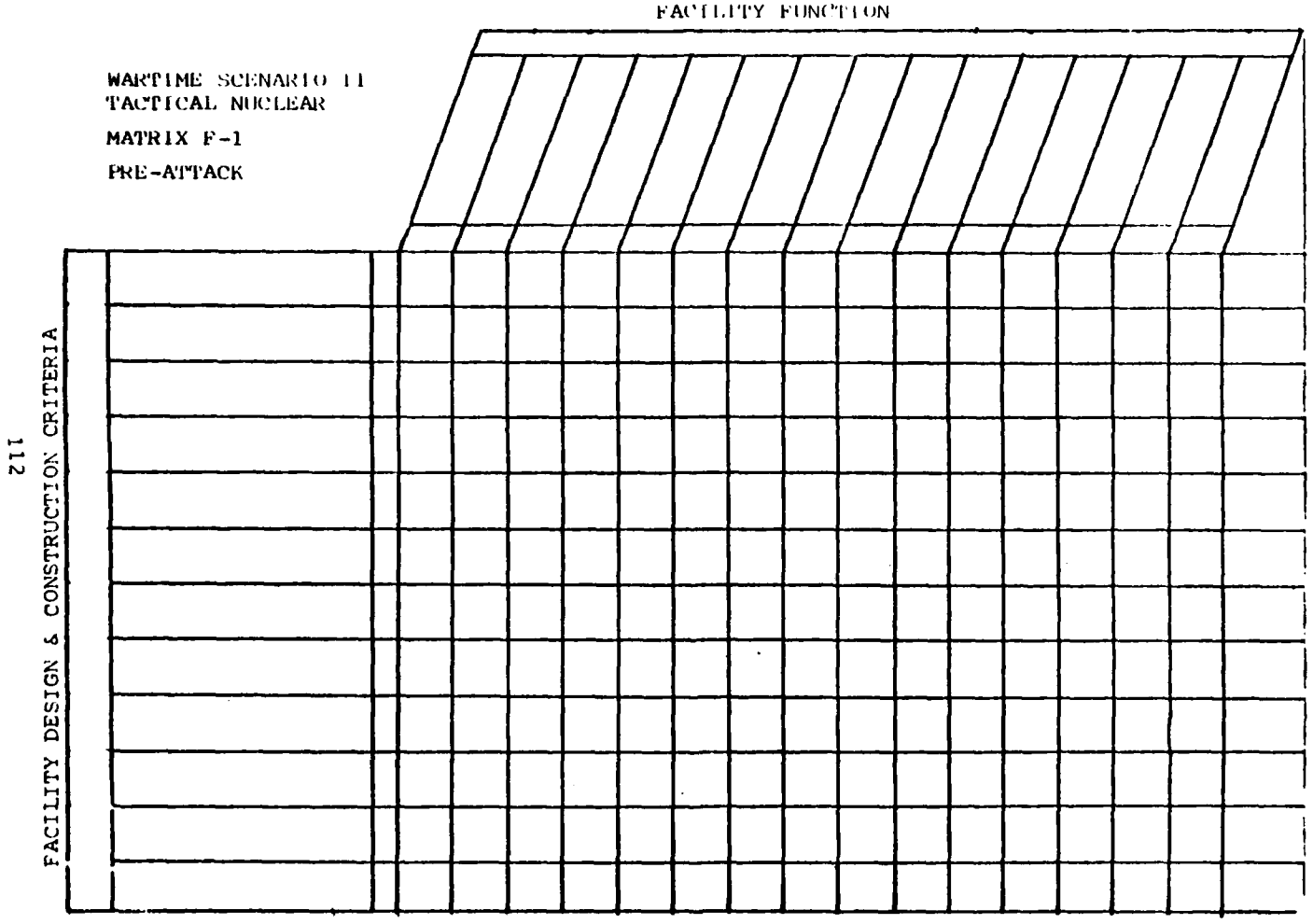
SCENARIO CONDITIONS

WARTIME SCENARIO II
TACTICAL NUCLEAR

MATRIX C-1

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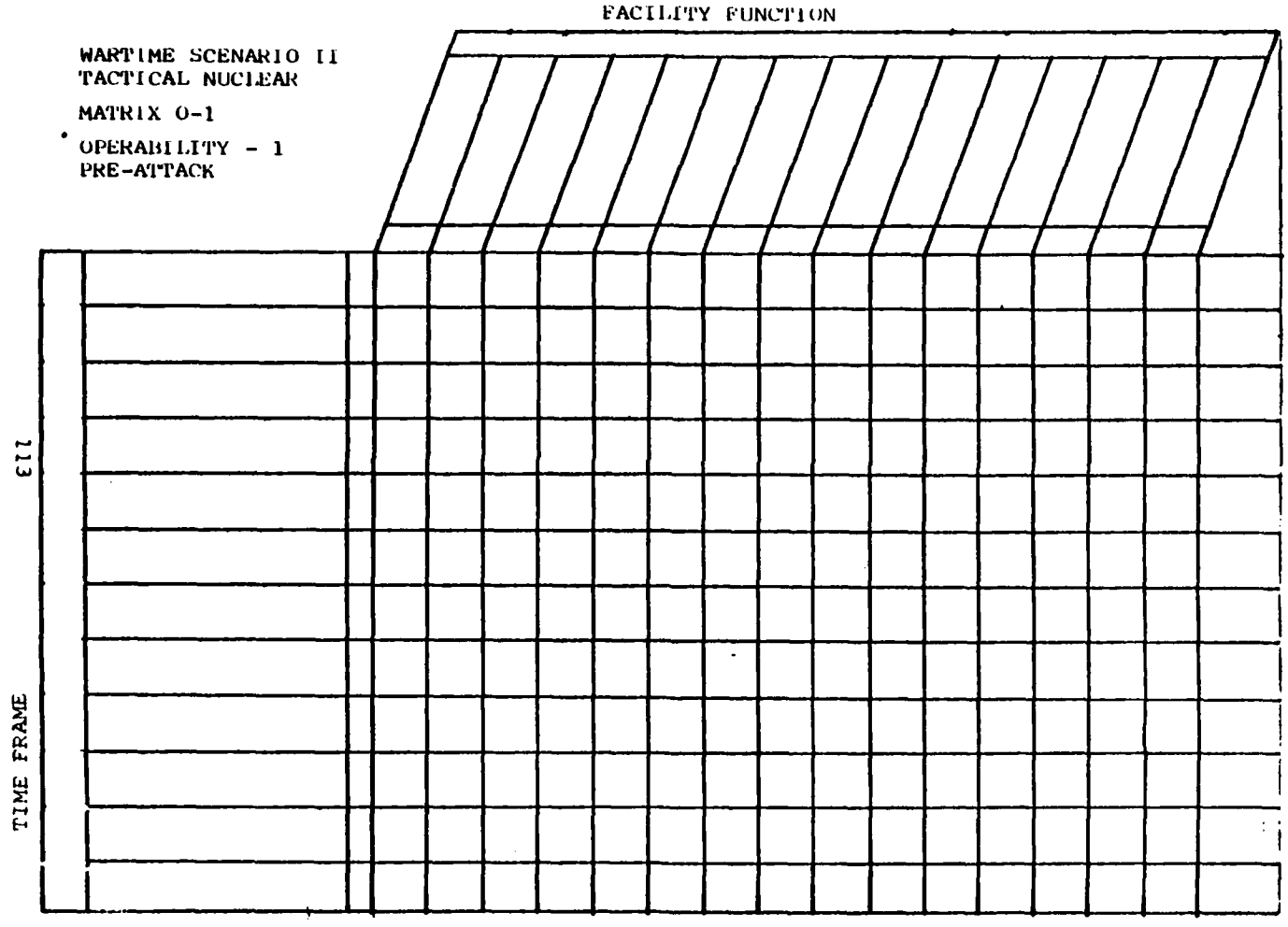
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OPERABILITY - 1
PRE-ATTACK
TIME FRAME
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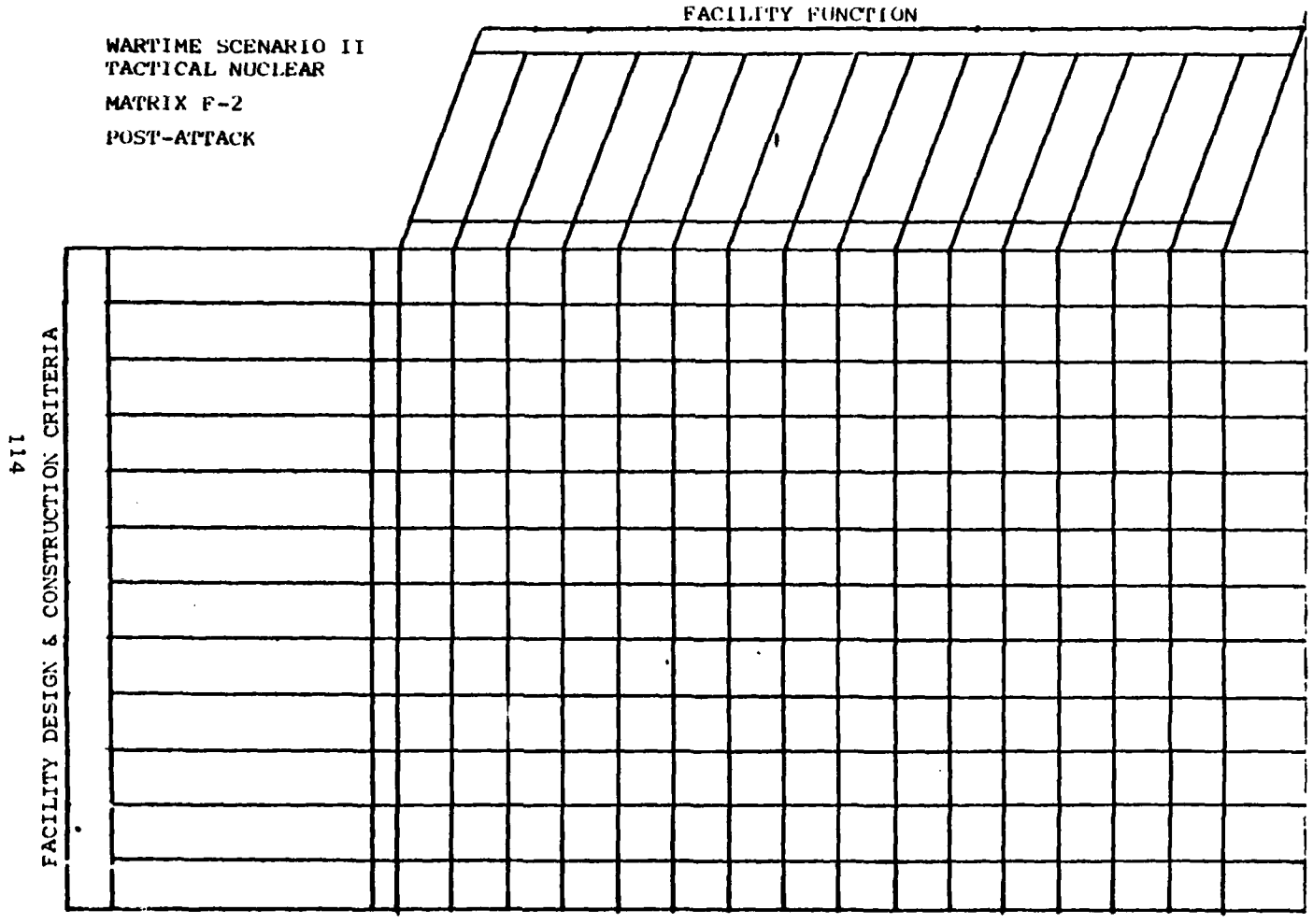
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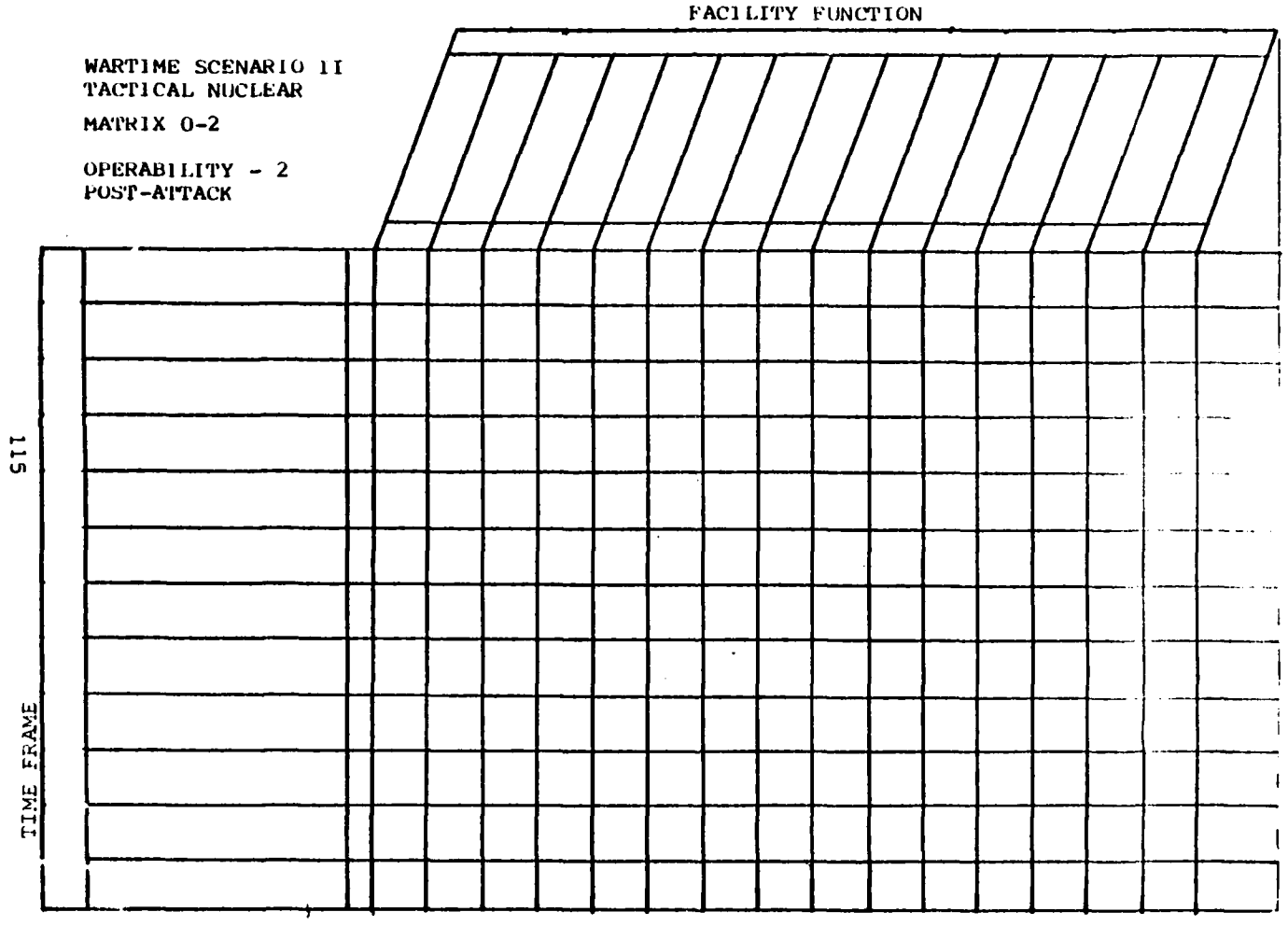
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TACTICAL NUCLEAR
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OPERABILITY - 2
POST-ATTACK
SII
TIME FRAME

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